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Public Benefactions and Science.

LORD NUFFIELD'S munificent gifts to the University of Oxford are worthy of admiration and imitation. They must have a strong appeal to the more enlightened and wealthy communities in India, and hopes might be entertained that the Indian Universities and other research institutes would likewise benefit by the philanthropic and patriotic instincts of the rich landed proprietors and industrial magnates in this country. The conservative temperament of the Indian mind has not understood the full significance of the somewhat cryptic saying, "cast thy bread upon the waters," for generally it fears, that instead of finding it after many days, it may be totally lost. The sage's assurance that it would return in increasing abundance ought to inspire public confidence. No thoughts of personal gain underlie public benefactions, which are made solely with the object of assisting the work of self-dedicated scientists, whose labours result in the benefit of our own generation and the generations yet unborn. Practically in every instance, material prosperity is absolutely dependent upon the patient researches of those who seek for no personal reward, and whose work at the time was thought by men of affairs to be of no consequence. It must not be forgotten that the foundations of our greatest present-day advances were laid by scientists, and the increasing returns, which men of business reap, have originated in work inspired by no thought of personal gain. Of all the human activities, perhaps the one thing that cannot be overproduced is scientific research, and we can conceive of no time and no situation when industry cannot utilise it. Nothing can be more clear than the fact that the substitution in economics of the law of increasing returns in the place of its old antonym, demands the continuous and increasing support of scientific research, which is the foundation of progress. The country which hesitates to strengthen and extend research in the domain of pure science

voluntarily renounces its claim to independent economic existence, content to seek its prosperity in the foot-paths and by-lanes of international progress.

Generally speaking, India looks at public and private philanthropy from the spiritual standpoint, and she treats mechanical civilisation as synonymous with materialism. Further, the unhappy association of science in developing the technique of modern wars has tended to diminish public faith in the benefits conferred by it on humanity. Even enlightened persons are apt to interpret the achievements of science in terms of material benefits, because they are more tangible, and their more enduring spiritual message escapes attention probably because their reality is less manifest. Our knowledge of Nature has opened out a new outlook on the significance of life, and the old superstitious beliefs and mystical rites have disappeared in proportion to the appreciation of the reasonableness and orderliness of the fundamental laws of nature. In emancipating the human mind from mediæval mysticism, science has also provided spiritual opportunities all along its progress. Science, while it acquires increasing power over Nature, places all its resources for the service of man. Science is non-moral. It shows the path of increasing human health and comfort. It also provides those who would erect a superstructure of industrial application with the increasing means of augmenting national prosperity. The researches in the field of chemico-medical sciences promise to prolong life and promote its efficiency. The recent advances in the domain of economics and sociology have acquired a body of knowledge which seems capable of fertilising society with a fresh and vivid life-giving stream of benefits. As a result of researches in basic sciences, rural occupations have opened out numerous problems upon whose satisfactory solution depend the happiness and contentment of the millions of the village population, whose present standard of living, sanitation and indebtedness must be a reproach to civilisation.

Scientific research is generally considered as a luxury by government and the public, and not as a fundamental necessity for making life better, cleaner and richer. It postulates the new law of increasing returns, which can be reaped only when its structure is strengthened and extended. Public opinion in India is still slow to recognise that the frontiers of science are unlimited and that industry and the nation owe to its efforts in extending the field for cultivation, continued and unstinted support. Industry was the first to benefit by the application of scientific results, but we have not utilised the new knowledge of a far-reaching and fundamental character in promoting our means to health and our economic and social orders. Scientific discoveries are an investment, and the public have not yet placed this intellectual property on the status of a national asset. If a fraction of the public enthusiasm and private money now expended on activities of a general and doubtful import, could be engaged in support of the Universities and research institutes in India, and if this support is not intermittent and wasteful, this country within a generation may be reasonably expected to achieve sufficient progress to make up for all its arrears. Encouragement of scientific work in India has not yet acquired the status of public obligation of sound management in the minds of her wealthy people, who too often rely on government for financial support. To the building of national greatness, the contribution of government is small, and its foundation and edifice are the work of discriminating philanthropists.

The political power with which India is shortly to be invested for the management of her affairs involves an imperative obligation on the part of her wealthy communities to recognise that in this country the rapidity with which industrial development and economic independence could be achieved must be proportional to the encouragement accorded to science. As a practical measure for sustained national progress, we believe that a fairly comprehensive plan should be immediately adopted for encouraging capital to enter the field of new scientific developments. Where scientific institutions receive private endowments we can confidently look forward to stimulating contributions not only of a theoretical value, but also to those which would not exclude social problems and their constructive integration, but emphasise them.

From Vitamin C to Vitamin P.

By Prof. A. Szent-Györgyi.

(*Professor of Organic and Medical Chemistry, University of Szeged, Hungary.*)

MY first real interest in Biochemistry was in the function of the adrenal cortext. At that time we only knew, that this internal secretory gland was essential for life. Without this organ life failed. Furthermore, we knew, that patients, suffering from the deficiency of the gland, turned brown, before dying. Bananas and pears do the same. The pigmentation of dying vegetable tissues has been shown by Palladin, the great Russian plant biochemist, to be due to a disturbance in oxidation-reduction equilibrium. So I hoped, oxidation-reduction processes will explain to me the function of the adrenal cortex. But we knew too little about oxidation systems too. So I set out to study first animal, and later vegetable, oxidation systems. The first systems analysed, that of succinic oxidation in muscle, and the polyphenoloxidase in potatoes gave me no clue, but while analysing the peroxydase systems in turnips, I found there was a substance present, which was capable of inhibiting the formation of melanoid pigments. This substance was a strong reducing agent, which reduced immediately oxidised phenols, before they could undergo further modification and form pigments. I isolated the substance and made its first approximate analysis, establishing its empirical formula and some of its more important characteristics.

It was a great excitement, when I found the same substance in relatively big quantities in the adrenal cortex.

The "isolation" and "identification" of this substance was not quite as easy, as writing these words down. It was not a simple matter and it needed not only involved technical equipment but also money and in the laboratory of the Physiological Institute of Groningen (Holland), where I was working at that time, none was available. Further researches on the isolation and identification were made possible by a friendly invitation by Professor F. G. Hopkins to join him at Cambridge, and by a generous grant from the Rockefeller Foundation.

Having established the main characteristics of this fascinating new substance I wanted to know more about it, especially its exact steric configuration, before attacking the problem of its biological activity. The trouble was however, that I had too little of it, only a few milligrams and I could make no more, because, of the labile nature of the substance. The only suitable material for large-scale preparations was the adrenal gland, which was not available in Europe in sufficient quantity. Prof. A. Krogh of Copenhagen tried to help me by sending me adrenal glands from Denmark to Cambridge by air. The material, however, deteriorated during transit and was therefore, useless.

Once more, international co-operation rendered fresh progress possible. Prof. E. C. Kendall, of the Mayo Foundation (Rochester, Minn, U.S.A.), invited me to Rochester and the rich resources of the Mayo Foundation together with the large quantity of material of the big American slaughter houses became available. The glands were packed in dry ice and shipped in this hard frozen condition to Rochester where the material was worked up; I was able to prepare as much as 25 g. of the substance. One exciting experience I had, was a clinical trial on Addison patients with adrenal insufficiency. The patients failed to get better, but they bleached out!

Returning from the States I shared my substance with Professor Haworth at Birmingham, who was deeply interested in it. His long-standing experience with carbohydrates, enabled him to investigate the steric configuration of the molecule. The substance unfortunately proved to be insufficient for the work and there was no chance of preparing it again.

After settling down to a more quiet life in my own country, in Szeged, Hungary, I found an opportunity, to put to the test an old suspicion of mine, (for investigating which my earlier roaming life was unsuited): whether the substance, which I had in my hands for five years, was not identical with the long sought Vitamin C. I started the work in collaboration with an young American, Svirbely, in the autumn of 1932. In November, we had the first definite answer. The animals treated with our substance, which we used to call "Hexuronic acid" all lived, while the controls all died. Owing, however, to defective diet (we had difficulty in securing milk powder), the weight curves were not satisfactory. So we repeated the whole experiment, before we

published our result in March of the next year. Meanwhile, also King and Waugh at Pittsburg isolated from lemon juice, a crystalline substance which was antiscorbutically active and which resembled our preparation of hexuronic acid. Also Tillmans in Germany found at about the same time, a close parallel between the reducing power and vitamin content of plant juices, which made the identity of hexuronic acid and Vitamin C probable.

Our substance was thus, according to its newly discovered activity, rebaptised now, and called "Ascorbic acid". By its vitamin nature the substance acquired increased importance and it was the more regrettable to have none of it. This difficulty was solved by an unforeseen discovery.

Szeged, the city in which my Laboratory is situated, lies in the middle of the Hungarian paprica—red pepper, *Capsicum anuum*—fields. I once tested paprica for its Vitamin C content and found it a rich storehouse of Vitamin C. Large-scale preparation gave good yields and in two consecutive years I could prepare about 4 kg. of ascorbic acid, providing all laboratories of the world which were wanting to work on this substance with ample material. This work was not without results. Professor Haworth at Birmingham soon established the steric configuration of the substance and its synthesis was effected both by Reichstein at Zurich and by Haworth.

In this way the most mysterious vitamin, which so long resisted analysis, succumbed to laboratory investigation. At present, it is produced synthetically on a big scale at a very low price, so that it is available for all those who are in need of it; and all this in the incredibly short time of hardly two years. This is what international collaboration and understanding can do.

Further research showed ascorbic acid to be an essential part of our diet. I myself went back to my old line of research, *viz.*, oxidation, which led me to Vitamin C. I forgot ascorbic acid and the ascorbic acid people forgot me.

Only in the last months have old reminiscences begun to awake again. As I mentioned at the beginning, I was led to the discovery of ascorbic acid by the analysis of the peroxydase system. At that time I also found, that peroxydase + peroxide oxidised ascorbic acid reversibly. This reaction occurred only, if there was an aromatic substance present, which induced the reaction. Peroxydase had no direct effect on ascorbic acid; it however oxidised aromatic substances to quinols, which, in their turn, oxidised ascorbic acid. I wondered which aromatic substance was playing this rôle in the plant, especially in lemons. I was led to a very peculiar new substance, which seemed to belong to the widely spread group of vegetable benzo-pyran dyes, the flavons. I suspected that this substance might have a vitamin nature too. Only there was no animal test for its study. So I put the substance aside in the hope, that at some later date I might find one such. Now nature seems to have given us a suitable test in the form of certain human pathological conditions, such as the Hæmorrhagic Diathesis (vascular type). My friend, St. Rusznyák, Professor of Medicine, has told me, that he had some very good cures of such conditions with paprika, but the effect was not due to the ascorbic acid present. To what was it due then? The same effects could be obtained with lemon juice. We set out to investigate the question and to find the substance responsible for this activity. And in the end we found it. It was nothing else than my old friend, the flavone, carrying the reaction between peroxydase and ascorbic acid. The crystals of the substance had the same therapeutic effect, as the whole pepper. They cured in a striking way disorders of the permeability of the capillary wall. So we gave the name "Vitamin P," to this flavone and we are hopeful, that in its ability, to reduce human suffering, this new substance will be no less important than ascorbic acid.

If the vitamin character of this substance be firmly established, this will also mean that the great group of vegetable dyes, the flavones, which seem to play such an important rôle in plant biochemistry, also function in the animal organism. So the substance will form a new chemical link between plant and animal physiology and may bear new evidence for the big chemical unity of living matter.

The researches on ascorbic acid described in this article serve to bring out certain features characteristic of modern research. Thus, work on some fundamental problems yields results quite unsought and opens up vistas quite unsuspected; rapid advance is dependent on international collaboration and in modern research investigations of microquantities of substances should proceed side by side with the preparation of materials on a large scale using tons of raw material.

Researches on Galaxies at the Harvard Observatory.

By (Miss) Jenka Mohr.

(Harvard College Observatory, Cambridge, Massachusetts, U.S.A.)

AMONG the many attempts of mankind to survey the universe, astronomy is almost unique in its combination of sweeping fields and sharp limitations. It reaches further into space than any other science; and it finds the demands of space and time more binding. Vast distances and dimensions are involved; processes are exceedingly slow, in terms familiar to man. The result is a constant challenge to man's ingenuity to devise techniques and to interpret observations.

Some of the problems that confront us when we examine our own galaxy, the Milky Way, also need solving when we study the distant universes that make up the rest of the Cosmos. Questions of size and structure, of dynamical conditions, are the same. There is the same analysis of the population of our own and other galaxies near enough to be examined in detail—stars and star clusters, gaseous nebulæ, stars that vary in light. (It may be pointed out that the terms "galaxy" and "nebula" are frequently used interchangeably to mean a great organization of stars. But since the word "nebula" is also used for the bright or dark clouds of gas or dust particles which are characteristic elements in many galaxies, we shall use the term "galaxy" mainly in the following account.)

Because we are involved in the midst of the Milky Way system, and at a great distance from all the others, there are many problems that arise only when we look beyond the Home Galaxy. The most essential problems deal with the general structure of the Metagalaxy, as the system of all such organisations of stars is called. What is the nature of the Cosmos? How many, and of what kinds, are the elements it comprises, and how are they disposed throughout space and time?

Again, we can study some of the distant galaxies to greater advantage than we can examine our own system. It is extremely difficult to obtain information about the Milky Way as a whole. We are not sure whether it is a single spiral or a group of smaller galaxies or an irregular system. The presence of absorption, the crowding of stars, the difficulties of obtaining perspective, throw us into confusion and uncertainty. But the other galaxies are observable from the outside. In some of the nearer ones, such as the Andromeda Nebula and the Magellanic Clouds, we can even study individual stars and clusters and gaseous nebulæ. Thus we are much more likely to learn what a typical galaxy is like by leaving the Milky Way, and exploring the neighbouring systems.

(1) One of the most fruitful sources of information about the structure and contents of an individual galaxy is the pair of systems lying close to the Milky Way, and probably functioning as its satellites. The Large and the Small Magellanic Clouds are much closer to us than any other external system—they are not a hundred thousand light years distant. Even a small telescope reveals something of their nature. Larger instruments show plainly many thousands of their stars, and other conspicuous features. At the Harvard Observatory a number of studies have been directed to the analysis of the Clouds as typical galaxies. Some of them are here briefly mentioned:

(*a*) The Clouds have been the source of considerable material on variable stars, which furnish the yardstick for measuring great distances. Over three thousand of these fluctuating stars are now known in the two Magellanic Clouds.

(*b*) A number of globular clusters found on the borders of each of the Clouds in the past two years have increased their recognised diameters considerably. The Large Cloud is now known to be about eighteen thousand light years across, and the Small Cloud about twelve thousand.

(*c*) Spectrographs of the brightest stars in the two Clouds are being taken with the 60-inch telescope. They will yield definite values of the radial velocities, and possibly information on the rotations of the Clouds—valuable material for the study of the dynamics of a galaxy.

(2) A recently developed type of analysis which is being extensively used at the Harvard Observatory on the brighter galaxies is the method of densitometer measures. Photo-tracings across the images of nebulæ are made which indicate the distribution of intensity of light. Thus two phenomena can be examined with considerable accuracy—the diameter of the object and the changes in density of luminous matter across its

surface. Diameters have been measured on many photographs, and the results show that the galaxies are very much larger than they had been believed to be. The outer extensions are much fainter than the central regions, and therefore not visible to the eye in examining photographic plates. The results are of inestimable importance in dealing with many problems of galactic structure —primarily, for example, the heretofore unexplained disparity between the two principal types of galaxies, spiral and spheroidal objects. The latter, an almost featureless type of galaxy, had been estimated as much smaller than the spiral form ; but the densitometer measures indicate that the diameters of the spheroidals are increased by the faint extensions more than are those of the spirals. Thus an apparent discrepancy in the workings of nature has been to a large extent removed by our increased knowledge of the phenomena.

(3) The distribution of the galaxies on the celestial sphere and their distribution through volumes of space are of primary importance in a study of the Metagalaxy. In order to get complete knowledge of such distribution, large regions of the sky should be examined, so that the accidents attendant on small samplings will be obviated. For this purpose the Harvard Observatory is using at both the Northern and the Southern Stations telescopes which combine a fairly large field with space-penetrating power. On a single photograph there is covered an area of thirty-five square degrees of the sky ; and nebulæ to the eighteenth magnitude—which means, roughly, to a distance of seventy five million light years—can be recorded in an exposure of three hours. Thus, with a reasonably small number of photographs taken on adjoining regions, several hundreds of square degrees are examined as a unit.

The Harvard survey of galaxies to the eighteenth magnitude has so far revealed on photographic plates some hundred thousand previously unknown galaxies, in both the southern and the northern skies. One significant fact that appears is the unevenness of their distribution. Although in many regions they appear with average frequency, in others they are surprisingly scarce ; and in still others, more surprising, there are very great concentrations. In the south, for instance, in the neighbourhood of the constellation Horologium, is a very extensive area of extraordinary richness. Here the galaxies seem to form a great stream, or cloud, many times more dense than the average. Within this Metagalactic Cloud of universes are several small spots of extreme density—spots in which the frequency is a hundred times the normal. Such clusters of galaxies are found scattered over the sky. They cover, to be sure, only a small portion of the entire sphere ; but no description of the Universe, or theory about it, can be complete that does not take into consideration these irregularities in the cosmic scheme.

(4) Clusters of galaxies are of interest not only for the rôle they play in the structure of the Metagalaxy. They also provide an opportunity for the study of relative sizes and brightnesses of individual members. All objects within a cluster may be considered as being at the same distance from us. Thus the variations in diameter and brightness can be taken as absolute differences. A study of twenty-five groups of galaxies, ranging in population from less than a dozen to several hundred, has been published by Dr. Shapley. About a score of clusters of galaxies discovered on Harvard plates are as yet unpublished. A programme is now being carried on at the Southern Station for the analysis of some of these groups with the 60-inch reflector which will yield large-scale photographs for detailed study of their members. It will also bring more complete knowledge about the numbers and magnitudes of individuals in the clusters.

(5) Still another aspect of the studies of galaxies at Harvard, while being a part of the attack on the outer Cosmos, has a direct bearing also on the analysis of our Milky Way system. This is the examination of regions lying close to the plane of the Milky Way which are rich in external galaxies. The heavy obscuring material in the central plane of the Milky Way has a two-fold effect. It hides the distant galaxies in the line of sight, and also makes it extremely difficult to measure the Milky Way itself. Stars near the centre of our system are dimmed by this nebulosity ; and therefore when the attempt is made to judge their distances by using measures of their apparant brightness, the results are false. For the absorption makes the stars seem fainter, and thus more distant, than they really are. Any measurement of the size of our galaxy must be corrected for the effect of the interpenetrating material among the Milky Way stars.

Dr. Shapley has pointed out that in places along the plane of the Milky Way where the

obscuring material is very thin, or even absent, there is little or nothing to hide the systems lying beyond. On a number of plates covering these areas galaxies have been found in normal abundance, as they would be in high latitudes where the obscuration does not occur. Dr. Shapley has used the presence in these low-lying regions of numerous galaxies as an indication of freedom from obscuring matter in our own system. He has studied variable stars in these areas in the Milky Way, which he can use safely as distance-indicators, without fear of false estimates of their brightness. The small amount of obscuration that may occur can be easily corrected for. In one region almost directly in the line to the center of the Milky Way he has found such freedom, and a study of periodic variables discovered there has shown more than a hundred stars which must lie far beyond the center itself. This is the first certain penetration into the far side of the Milky Way, and stars are now known which are further beyond the center than we are on this side of it. The research is of great importance, both in furthering our knowledge of the size of the Home Galaxy and in analysing more exactly than heretofore the structure of the dark material within it.

An open spiral, showing spiral arms, condensations of stars, and obscuring material among the arms.

N. G. C. 5236 (Messier 83).

Position : R. A. = $13^h\ 34^m{\cdot}3$, Dec. = $-\ 29°\ 57'$.

(This picture was taken with the 60-inch reflector of the Harvard Observatory at the Southern Station, Bloemfontein, South Africa, by Dr. J. S. Paraskevopoulos.)

The studies listed above represent some of the explorations that are designed to give a consistent and detailed picture of the Metagalaxy. Limitations of space have made it necessary to omit discussion of other allied programs now being carried on at Harvard. There is, for instance, a study supplementing the earlier work on the galaxies brighter than the thirteenth magnitude over the entire sky. The new work goes to the fifteenth magnitude, and thus augments knowledge of the "inner Metagalaxy". There is also the investigation of variable stars in our own system in high latitudes, which outlines the Milky Way in its minor diameter. Such problems necessarily entail a great deal of laborious routine, and can bring final results only after some years of continued research.

The past decade or two have seen the opening of many doors into the outer world. The present time and the coming decades will bring observational material by which we can fill out the picture of what lies beyond the Milky Way.

The Phenomenon of Secondary Association.

By Dr. R. H. Richharia.

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THE discontinuity of chromosome associations observed at diakinesis and I metaphase in Prunus by Darlington (1928) led to the discovery of the phenomenon of secondary associations or secondary pairing. He suggested that the chromosomes showing this kind of affinity are related. This theory of secondary associations was further developed by Lawrence (1931 *c*) who adduced cytological and genetical evidence in favour of this theory and cited evidence of its occurrence from literature. Polyploidy occurs very frequently in the plant kingdom (at least fifty per cent. and probably more of the Angiosperm species, *cf.* Müntzing, 1936), hence this phenomenon is to be expected in all such forms. This has been now studied and described in detail by several workers in different materials: Lawrence (1929–31 *a* and *b*); Darlington and Moffett (1930); Moffett (1931); Meurman (1933); Wanscher (1934); Gustafsson (1935 *a*); Matsuura (1935); Heilborn (1935–36); Catcheside (1934); Gates (1935); Sakai (1935); Alam (1936). Recently Heilborn (1936) points out that he had already observed such associations in his studies on Carex (Heilborn, 1924) where he had also suggested that "this should probably be regarded as an expression of affinity between homologous gemini which arrange themselves in short rows of generally 3–5." He now thinks that "secondary association of chromosomes results from the action of the forces of nuclear division upon chromosomes of different size and mass," and he thus generalises, on insufficient grounds, that the chromosomes of equal size are associated irrespective of homology. Moreover, the presence of secondary pairing among chromosomes of unequal size observed (Richharia, 1936 *a* and *b*) is probably in direct contradiction to Heilborn's hypothesis, while the theory of secondary pairing allows such associations.

So far this phenomenon has been used only to determine the primary basic chromosome number, and has been shown to occur among bivalents which are morphologically the same. In our investigation (Richharia, 1936 *a* and *b*) on four Brassica species, *viz.*, *B. oleracea* ($n = 9$), *B. chinensis* ($n = 10$), *B. pekinensis* ($n = 10$), *B. Rapa* ($n = 10$) and *Raphanus sativus* ($n = 9$) associations among morphologically dissimilar types are observed. It has been suggested that such a condition may be due to certain structural rearrangements of chromosome parts, such as segmental interchange, fragmentation, translocation, etc., besides reduplication. Under these circumstances it will not be possible to disclose correctly the primary basic number in such forms. If such a hypothesis of "structural rearrangements" in explaining the secondary associations in these forms is correct it should be possible to detect such phenomena genetically. For example, Muller (1930) has shown in Drosophila that the translocations do to some extent influence the segregation of chromosomes, etc. It is quite probable that as a result of some sort of genetic balance or mutation primary pairing forming ring or chain does not occur in these forms and this relationship is shown only in the form of secondary associations. It is interesting to point out that Afify (1933) observed secondary pairing in *Lycopersicum esculentum* × *L. racemigerum* but not in the parents. He gives the following explanation for such a behaviour (p. 236). "It may be suggested that this secondary association in the hybrid is the result of the lack of sufficient homology between the chromosomes of the two parents. In other words, the homology between the corresponding 12 chromosomes contributed from each parent is not as strong as in the pure species. Consequently there is not a satisfactory primary association at the prophase of meiosis, and to fulfil their capacity for further pairing, they pair at metaphase through secondary association." He also points out some objections to the soundness of this explanation. The same behaviour may be explained on the following assumption: "Let us represent two chromosomes from each gametic set by **AaB, CcD** and **AaD, CcB** respectively. It is evident that under these circumstances no secondary association will occur in the parents but in the hybrid the two bivalents with the constitution $\frac{\mathbf{AaB}}{\mathbf{AaD}}$ and $\frac{\mathbf{CcD}}{\mathbf{CcB}}$ would form secondary pairing because of the presence of common B D." Heilborn (1936), however, suspects that the secondary association observed in this case may be due to bad fixation, which is hardly true.

This phenomenon is not confined to bivalents only. Whenever univalents fail to pair at prophase, possibly due to weak homology, they form secondary associations at I metaphase. This has been observed in swede × turnip cross by Catcheside (1934), Triploid *Pyrus minima* ($2n = 51$) by Moffett (1931), Taraxacum by Gustafssan (1934 *a* and *b*) and in Raphanus × Brassica hybrids by Richharia (1936 *a*).

It is held that secondary associations possibly do not affect segregation. But it is worth noting what happens in male Drosophila where crossing-over does not occur (especially see Darlington, 1934). Here chiasmata are not formed and the chromosomes are seen secondarily associated followed by regular segregation. It may thus be suggested that it is quite possible to expect similar behaviour with some secondarily associated univalent pair as well.

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A Forgotten Authority on Lac Cultivation.

By S. Mahdihassan.

THE late Prof. Lefroy[1] once observed that the Indian lac experts do not seem to know anything of what is being done outside India. Unfortunately, it can as well be said that they do not even know all that has been published in India. An interesting publication on lac cultivation has not been referred to in the subsequent works on the subject, including the most recent book by Glover[2] and the Bibliography on Lac, published by the Lac Research Institute, Ranchi.[3] The forgotten Report is entitled, "A note on the cultivation of lac in Jangipur Subdivision of Murshidabad," by Romesh Chander Sirkar, dated 10th April 1904. It may be pleaded that the above publication contains nothing of importance; and, if so, it only reveals lack of appreciation of an important phenomenon to which I have devoted more than one publication.[4]

The variations among lac crops have been attributed to the mysterious effect of the weather. On the contrary I have explained how the yield regularly differs from locality to locality and from season to season, when we consider the following chain of factors: Excessive soil moisture, dilution of plant sap, increase in water content of eggs before fertilisation, preponderence of males in the next generation, the ultimate poor yield of the lac crop. At Ranchi they tried to verify such observations, without, however, mentioning any of my publications, and commented as follows: "*An* experiment was carried out to discover whether moisture was a factor governing male to female ratio.....*Experiments* so far have not shown moisture to be this factor."[5] (Italics are mine.)

Ranchi is apparently not so forward as to form an exception to Holdaway's[6] remark, "Little attention has been given.....to the effect of humidity on insect populations." From his own experience he has been able to state, "Sex ratios of adults derived from parents or from eggs which had been maintained at respectively different moisture conditions were different.....In this connection it is of interest to recall Mahdihassan's results, published in 1924 and 1926, on the change in sex ratios of lac insects to moisture condition associated with the season."

Granting that soil moisture does ultimately produce a progeny rich in males, a dry locality would produce good quality brood lac. Likewise in a large geographical area with elevated lands or hills with a well-drained subsoil would produce good brood lac, while the plains, rich in subsoil moisture, would be producers of inferior quality.

Sirkar considers, "the local insects (from the plains of Murshidabad) of a rather delicate nature," for they apparently die in numbers and thus the surviving members can only produce little lac. What he actually observed was a small survival ratio in the colonies of local origin, with a great deal of space separating isolated females and this space was imagined to be due to the high death rate among the female larvæ. On the other hand what he considers as the hardier insect, he "procured from Salgara-Pahar and Dumka-Pahar, *i.e.*, from the hilly tracts in the Sonthal Parganas, and introduced" them on his experimental trees. He adds, "Both the Pahari insects, *i.e.*, insects produced from the hill tracts and the local insects, were inoculated on the branches of the same trees." His experiments showed, "the Pahari insects were hardier (with a smaller death rate) and a little later in maturing than the local one." He finally writes, "I thought it better to inoculate both the varieties on the branches of the same trees and watch the result.... The Pahari lac incrustations were found to grow thicker than the local ones (from the plains). The Pahari insects deposited a layer, about one-fourth inch thick, of incrustation all round the upper three-fourth part of each branch, and thereby yielded a greater quantity of lac; while the local insects produced thinner deposits at intervals all along the branches."

A few comments are necessary to explain the importance of Sirkar's observations somewhat naively expressed.

1. He established a difference of quality in broodlac derived from an elevated locality and from the plains. This is a fact.

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[1] *Pidance's Report on Lac-refining*, Hyderabad-Deccan, 1930.

[2] *A Practical Manual of Lac Cultivation*, Ranchi, 1931.

[3] *Bibliography of Lac*, 1933.

[4] *Proc. Roy. Acad. Sc.*, Amsterdam, 1933, **36**, No. 3.

[5] *Ann. Rep. Lac Res. Inst.*, Ranchi, 1930, 30.

[6] *Ecological Monographs*, July 1932, **2**, No 3, p 268.

2. The broodlac from the hills gave rise to a generation which matured later. This can be explained as due to a greater ratio of females and the consequent competition for food, hence the slower rate of maturity; this difference, as Sirkar himself remarks, was not great.

3. Insects from the plains produced deposits thinner and at intervals. When a young colony with a preponderence of males is observed in the first larval stage, the colony appears densely populated. Two months later the males have emerged and the relatively few females appear scattered or isolated. The impression, and only an impression, is left that many female larvæ have died meanwhile, accounting for the empty gaps. By the time such a generation is fully developed the encrustation is thin and at intervals, as observed by Sirkar.

4. Brood lac from the hills gives an encrustation which envelopes three-fourths around a twig. When a twig is growing horizontally and it is most intensely populated by a lac colony it is never all around the twig; only the undersurface and the sides are covered, or if a cross-section is taken the *lower* three-fourths of the circumference would show larval settlement. When such a colony has lived long enough to complete its life cycle, the piece of sticklac, held in hand and examined for the encrustation, would show the *upper* three-fourths of the twig, in section, covered with lac, as Sirkar remarks. The important point to observe is that the colonisation was as intense as it could possibly be, which means, the generation derived from broodlac sent from the hills had a high ratio of females.

It would be seen that all remarks and observations made by Sirkar are accurate in themselves and become perfectly intelligible only when we consider them as extended effects of a preponderence of females in the progeny derived from broodlac of a hilly locality, and there appears no reason to assume that the insect there was in any way hardier or different in variety.

Hautefeuille,[7] unbiassed by any preconceived ideas, acutely observes, "In Upper Tonkin, *Cajanus* (plants) intended for the production of sticklac and especially for insect reproduction or for broodlac is found in very suitable localities, somewhat elevated." The suitable locality is the elevated locality, naturally with a soil having excellent drainage. He likewise says the reverse condition is not good for lac propagation: "*Cajanus* plantations which receive colonies of insects.....need good alluvial soil which is not too moist." The moist unfavourable locality would correspond in Sirkar's experiments with the "plains". Sirkar also observed trees were growing "along the banks of rivers" and elsewhere liable to "occasional inundation"; apparently he never dreamt of utilising these trees for lac propagation for he never mentions them in connection with his observations on lac cultivation.

In order to extend lac cultivation in Indo-China[7] experiments were undertaken with broodlac procured through "coolies living in the mountainous regions." These "mountaineers came at much expense..... with brood-sticks and had been travelling for six days." It is apparent the broodlac from the hills must have an established local reputation, for otherwise it is difficult to imagine why it was not procured from a locality in the plains, which might also have been nearer.

In this connection I may add that Nicholson[8] reviewing different opinions with regard to elevation affecting lac cultivation, writes, "all the evidence in my opinion goes to show that elevation *per se* is a physico-geographical factor of no importance." By elevation which effects lac cultivation is to be understood that which is expressed in the contour of a land and in the movement of subsoil water; that which is measured in height above sea-level has naturally no bearing on it. Sirkar was thus the first to show experimentally that broodlac from a drier elevated locality is better than that obtained from the plains with a greater subsoil moisture.

[7] *Report on Lac and Its Industrial Treatment*, Hyderabad, Deccan, 1924.

[8] *Indian Forester*, 1925, **51**.

LETTERS TO THE EDITOR.

CONTENTS.

Density of Calcium and Hydrogen at Different Levels in the Sun.

A PHOTOMETRIC study of some of the prominent lines in the sun's spectrum at different points of the sun's disc has been carried out at the Kodaikanal Observatory.

As the sun's limb is approached the path of light through the reversing layer becomes more and more inclined to the vertical in the sun, but we find that the change in the contours of solar lines is quite different from that of terrestrial lines, such as the B band, as the path through the earth's atmosphere becomes more and more inclined to the vertical. In the latter case, the residual intensity at every point of the contour decreases with increased inclination of the path to the vertical, and the equivalent width correspondingly increases; whereas in the case of the solar atmosphere the residual intensity increases as the limb is approached, and the equivalent width correspondingly decreases.

This characteristic difference in the behaviour of solar and terrestrial lines in relation to the inclination to the vertical of the path through the atmosphere is due to the fact that in the case of the sun's reversing layer the photospheric background of continuous spectrum comes from a higher level as the limb is approached. The change in the contour of solar lines is a combination of two opposite effects :—(1) an increase in the number of absorbing atoms due to the increased length of path through the atmosphere as the inclination to the vertical increases, and (2) a decrease in the number of absorbing atoms as the effective level of the photosphere becomes higher. The first effect can be allowed for by geometric considerations, so that the change in the contours of solar lines can be used to measure the second effect. Hence we can measure the number of atoms lying above different levels in the sun, and consequently also the number of atoms between these levels. We have deduced in this way, the following values for the number of atoms per cm.^{3} at different levels in the sun:—

Height above photosphere	Number of atoms per cm.^{3}		
	Ca	Ca^+	H (2 quantum)
0 to 136 km.	$11{\cdot}3 \times 10^8$	$3{\cdot}68 \times 10^{11}$	$6{\cdot}13 \times 10^8$
0 to 287 km.	$9{\cdot}05 \times 10^8$	$3{\cdot}40 \times 10^{11}$	$3{\cdot}61 \times 10^8$
136 to 287 km.	$6{\cdot}95 \times 10^8$	$2{\cdot}55 \times 10^{11}$	$2{\cdot}01 \times 10^8$
0 to 600 km.	$5{\cdot}2 \times 10^8$	$1{\cdot}7 \times 10^{11}$	$2{\cdot}0 \times 10^8$
287 to 600 km.	$1{\cdot}6 \times 10^8$	$0{\cdot}4 \times 10^{11}$	$0{\cdot}2 \times 10^8$

The electron pressure is about 2×10^{-5} atmospheres at all these levels.

Although the number of H atoms in the 2 quantum state has been determined with reasonable exactness, it is well known that

the number of H atoms in the 1 quantum state in the sun is a matter of great uncertainty. Consequently the proportion of the metallic constituents of the sun is also very uncertain. Our results show that the proportion of calcium atoms is of the order of 0·6 per cent. of the total number of atoms present, a value about 10 times greater than Russell's estimate.

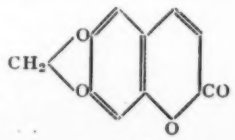
Further details of this work are being published in *Kodaikanal Observatory Bulletin No.* 109.

T. ROYDS.
A. L. NARAYAN.

Kodaikanal Observatory,
November 18, 1936.

On the Constitution of Ayapin.

THE isolation of pure ayapin from the leaves of *Eupatorium ayapana*, Vent. and its identity with 7-methoxycoumarin have already been reported by Bose and Roy.[1] The second crystalline constituent, obtained from the same source and named ayapin, melts at 219–20°. It imparts to concentrated sulphuric acid a sky-blue fluorescence. Ayapin was found to be free from methoxy groups but the presence of methylenedioxy group was indicated. Its analyses agreed with the formula $C_{10}H_6O_4$. Reduction with sodium amalgam in faintly acid medium gave a dihydro-compound, m.p. 175-177° which did not any longer show fluoresence in concentrated sulphuric acid. Treatment of ayapin with bromine followed by alcoholic alkali gave an acid, m.p. 269–71° (with evolution of gas) which is evidently formed as a result of coumarin-coumarilic acid rearrangement. We suspected ayapin to be a methylenedioxycoumarin, and this supposition has been confirmed by a synthesis of ayapin from 6 : 7-dihydroxycoumarin by methylenation. The identity of the synthetic 6 : 7-methylenedioxycoumarin (I) with ayapin has been established in the usual manner. So far as the authors are aware, ayapin is the first instance of a methylenedioxycoumarin found in nature.



(I)

P. K. BOSE.
S. K. GHOSH.

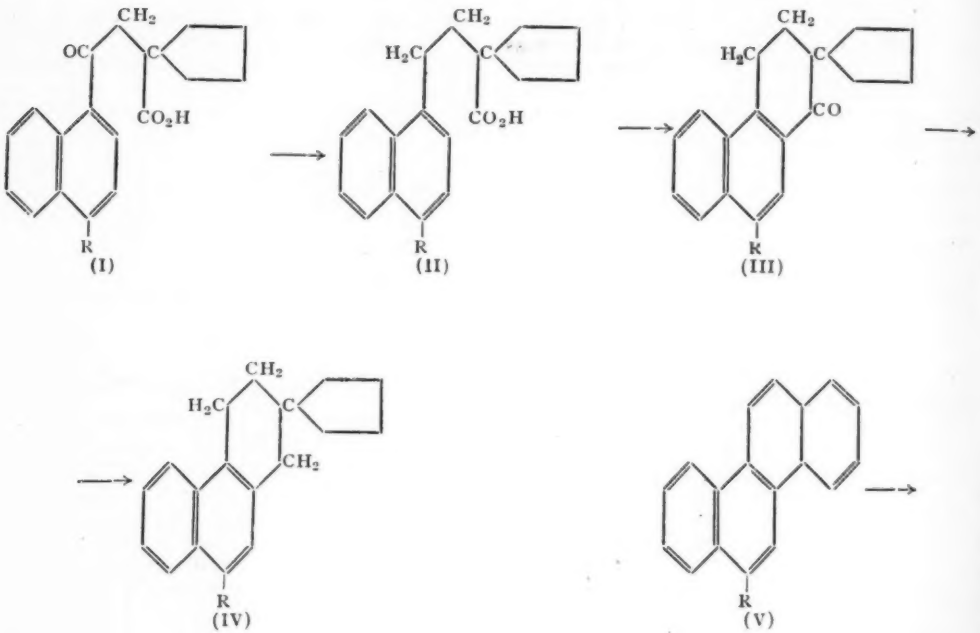
Chemistry Department,
University College of Science,
Calcutta,
November 20, 1936.

[1] *J. Indian Chem. Soc.*, 1936, **13**, 586.

Dehydrogenation and Ring-Transformation of Spiro-Hydrocarbons.

BY an extension of the method developed by the author for the synthesis of spiro-hydrocarbons[1], 1, 2, 3, 4-tetrahydrophenanthrene-2, 2-spiro-cyclopentane (IV ; R = H) and its 9-methyl derivative (IV ; R = Me) have been synthesised. And similar to the observations made in that paper, these spiro-hydrocarbons were found on selenium dehydrogenation to be converted by ring-transformation into chrysene and 6-methyl chrysene respectively.

The steps that led to the syntheses of these two spiro-hydrocarbons were as follows : The anhydride of cyclopentane-1-carboxy-1-acetic acid reacted with naphthalene in presence of anhydrous aluminium chloride with the formation of *αα*-cyclopentane-*β*-1-naphthoyl-propionic acid (I ; R = H) (m.p. 40–141°) and *αα*-cyclopentane-*β*-2-naphthoyl propionic acid (m.p. 191°). The former on reduction by the Clemmensen method gave *αα*-cyclopentane-*γ*-1-naphthyl butyric acid (II ; R = H) (m.p. 108–109°) which was cyclicised with 85% sulphuric acid to 1-keto-1, 2, 3, 4-tetra-hydro phenanthrene-2, 2-spiro-cyclopentane (III ; R = H) (b.p. 215°/6 mm.). This spiro-ketone was reduced by the Clemmensen method to the spiro-hydrocarbon 1, 2, 3, 4-tetrahydrophenanthrene-2, 2-spiro-cyclopentane (IV ; R = H), and the latter on selenium dehydrogenation at 300–350° gave only chrysene and no trace of benzanthracene could be detected. It may be noted here that both phenanthrene and anthracene were obtained by the selenium dehydrogenation of 1, 2, 3, 4-tetrahydronaphthalene-3, 3-spiro-cyclopentane.[1]



In a similar manner $\alpha\alpha$-cyclopentane-β-(4-methyl)-1-naphthoyl-propionic acid (I; R = Me)(m.p. 176–177°) was obtained from α-methyl napthalene and the anhydride of cyclopentane-1-corboxy-1-acetic acid. The methyl ester of this keto acid was reduced by the Clemmensen method to $\alpha\alpha$-cyclopentane-γ-(4-methyl)-1-naphthyl butyric acid (II; R = Me) (m.p. 112°), which on cyclisation with 85% sulphuric acid gave 9-methyl-1-keto-1, 2, 3, 4-tetrahydrophenanthrene-2, 2-spiro-cyclopentane (III; R = Me) (m.p. 97°). This spiro-keto compound on Clemmensen reduction yielded the spiro-hydrocarbon 9-methyl-1, 2, 3, 4-tetrahydrophenanthrene-2, 2-spiro-cyclopentane (IV; R = Me) (m.p. 69–70°). On dehydrogenation with selenium at 300–350° it gave 6-methyl chrysene (m.p. 152–53°) (V; R = Me).

The experimental details will shortly be published elsewhere.

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Chemical Laboratory,
Presidency College, Calcutta,
December 7, 1936.

[1] *J. Ind. Chem. Soc.*, 1934, 389.

Individuality of Ascorbic Acid Oxidase.

BESIDES the oxidation of ascorbic acid by peroxidase systems,[1,2] the presence in plant extracts of a specific enzyme capable of oxidising ascorbic acid has been assumed by different workers.[3,4,5,6] As such plant extracts are not free from peroxidase,—though Tauber *et al.*,[5] do not refer to this point—circumstantial evidence was obtained previously by the author[6] to show that the peroxidase accompanying ascorbic acid oxidase in drumstick, *Moringa pterygosperma*, had no rôle in the oxidation of ascorbic acid. As a peroxidase-free ascorbic acid oxidase alone could speak for its individuality, a preparation of such an enzyme has now been obtained, after careful search among different plant materials, in the *press* juice of the inner pulp of cucumber, *Cucumis sativus*. This juice was found to oxidise ascorbic acid rapidly (Table I) under optimum conditions[6] and was free from peroxidase systems as tested with the usual substrates and H_2O_2 and with starch-iodide (Table II).

TABLE I.

Ascorbic Acid Oxidase Activity of the Press *Juices of the Rind and Inner Pulp of Cucumber.*

Reaction mixture : 0·5 mg. ascorbic acid in a total volume of 5 ml. at *p*H 5·3 and room temperature (25° C.).

mg ascorbic acid oxidised in 5 minutes by		
No enzyme (control)	0·5 ml. rind juice	0·5 ml. pulp juice
0·0	0·56	0·57

TABLE II.

Peroxidase Activity (Bach and Chodat[7]*) of the* Press *Juices of the Rind and Inner Pulp of Cucumber.*

Recation mixture	Ml. iodine (= N/200 $Na_2S_2O_3$) liberated in 3 mins.
5 ml. starch—iodide[7]+0·5 ml. H_2O_2 (0·3%)[7] +0·5 ml. H_2O	0·41
5 ml. starch—iodide+0·5 ml. H_2O_2 (0·3%) +0·5 ml. pulp juice	0·39
5 ml. strarch—iodide+0·5 ml. H_2O_2 (0·3%) +0·5 ml. rind juice	1·59
5 ml. starch—iodide+0·5 ml. H_2O+0·5 ml. rind juice	0·00

The peroxidase which cucumber is known to contain was located in its rind, the *press* juice of which was also as active as that of the inner pulp in oxidising ascorbic acid (Table I), suggesting an even distribution of ascorbic acid oxidase in the pulp and the rind of cucumber. As the correctness of this suggestion rested on the inability of peroxidase of the rind to oxidise ascorbic acid, it was shown that the rind juice did not contain a peroxide (Table II, which, besides, gives peroxidase activity), a complement necessary for the oxidising action of peroxidase. Hence the capacity of even the rind juice to oxidise ascorbic acid is due to the specific oxidase and not due to the co-existing, but incomplete peroxidase.

Thus, ascorbic acid oxidase is individualistic and can occur either alone, or mixed with peroxidase (or other oxidases). So, wherever a peroxide-free enzyme system, capable of oxidising ascorbic acid is encountered, it appears safe to assume, in general, the presence of a specific and individual ascorbic acid oxidase.

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Department of Biochemistry,
Indian Institute of Science,
Bangalore,
December 4, 1936.

[1] Szent-Györgyi, *Biochem. J.*, 1928, **22**, 1387.
[2] Szent-Györgyi and Vietorisz, *Biochem. Z.*, 1931, **233**, 236.
[3] Szent-Györgyi, *J. Biol. Chem.*, 1931, **90**, 385.
[4] Zilva, *Biochem. J.*, 1934, **28**, 663.
[5] Tauber, Kleiner and Mishkind, *J. Biol. Chem.*, 1935, **110**, 211.
[6] Srinivasan, *Curr. Sci.*, 1935, **4**, 407
[7] Bach and Chodat, *Berichte*, 1904, **37**, 1342.

The Non-Protein-Nitrogen of Milks.

MILKS from different species of animals are known to contain an appreciable amount of the Non-Protein-Nitrogen (N.P.N.) fraction probably influencing their nutritive value in three ways : (1) affecting the peptisability of the proteins, (2) influencing their digestibility and (3) supplementing any deficiencies of the associated proteins. A study of this fraction is therefore of considerable interest.

The results presented in this communication relate to the partitioning of the N.P.N. fractions of the cow and ass milks by the Van Slyke's method and to the estimation of the urea and arginine contents by the application of enzyme methods.

TABLE I.

Percentages of Total Nitrogen.

	Ass Milk	Cow Milk
Melanin	7·02	6·03
Amide N	15·5	12·56
Non-basic N :		
Amino N	50·14	52·00
Non-amino N ..	2·76	1·65
Basic N	25·84	29·15
Total ..	101·26	101·49
Arginine (Van Slyke) ..	17·59	11·53
,, (Enzyme) ..	7·15	7·33
Urea (Total) ..	21·21	20·29

The results presented in Table I do not reveal any significant differences between the composition of the N.P.N. of cow and ass

milks. The higher values for amide are due to the partial decomposition of urea under the conditions of acid hydrolysis of the N.P.N. The actual values for amide, after correcting for the presence of the urea are respectively 2.0, 1.06 for cow and ass milks. The discrepancy between the values for arginine by enzyme and alkali methods can also be attributed to the residual urea present in the hydrolysate. It will be seen that as in the case of N.P.N. of pulses,[1] the arginine values obtained by the alkali method are distinctly higher and in the case of milk N.P.N. the higher values are due to partial hydrolysis of urea by alkali.

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Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 6, 1936.

[1] *Curr. Sci.*, 1936, **4**, 651; *Biochem. J.*, 1936, **30**, 1416.

A Note on the Mydriatic Effect of Cocaine in Cat's Eye and Its Differentiation from the Atropine Group of Alkaloids.

COCAINE, like the atropine group of alkolids, produces mydriasis in cat's eyes, but it was found that a watery solution of cocaine hydrochloride of a strength less than what is represented by 0.025 per cent. solution of cocaine base had no effect in the cat's eye even on repeated applications, whereas a solution equivalent to 0.025 per cent. of cocaine base reacted in the eyes of some cats, but produced no effect in those of others. The dilatation was noticeable in shade, but not in the sun or strong light. 0.05 ml. of 1 per cent. cocaine solution caused moderate dilatation in an hour as seen in the shade. In the presence of strong light the pupil contracted to a certain extent, but slight dilatation was still perceptible. In this respect cocaine differs from atropine, which reacts in the cat's eye more definitely in strong light.

0.025 per cent. (1 : 4000) of cocaine solution may be considered as the lowest which is capable of producing a mydriatic effect in cat's eyes, whereas a considerably weaker solution (1 : 130,000 according to Donders : Otto "Ausmittelung d. Gifte," 6te Aufl., 73) of atropine gives positive mydriatic reaction in the cat's eye.

Another point of difference is that a weak solution of cocaine (less than 0.025 per cent.) does not, unlike weak atropine solution, cause a cumulative effect in the eyes of a cat on repeated applications.

It has been found that a drop of 0.025 per cent. cocaine solution gives a positive permanganate reaction on a slide (*cf.* Hankin, *Analyst*, 1911, 2) if applied in the presence of a drop or two of N/25 HCl, specially when the liquid dries up.

This investigation was carried out under the facilities kindly afforded to me by Mr. D. N. Chatterji, B.A., B.Sc., F.I.C., the Chemical Examiner to Governments of the United Provinces and C. P., in his laboratory.

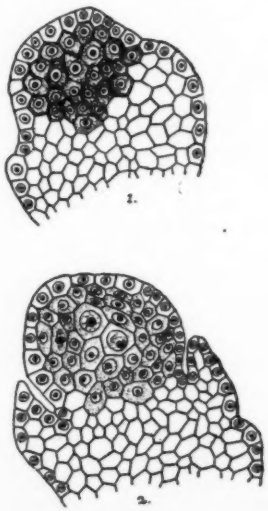
I am greatly indebted to him for his kind permission to send this paper for publication.

K. R. GANGULY.
Government Laboratory,
Agra,
October 12, 1936.

Megasporogenesis and Embryo-sac Formation in Two Species of Meliaceæ.

No previous work has been done on the morphology of Meliaceæ. For the first time two species of the Meliaceæ—*Cipadessa fruiticosa*, Bl., and *Melia azaderach* Linn., have been worked.

The archesporium consists of a group of cells, hypodermal in origin and easily recognised before the integuments are differentiated (*Melia*, Fig. 1 ; *Cipadessa*, Fig. 1).



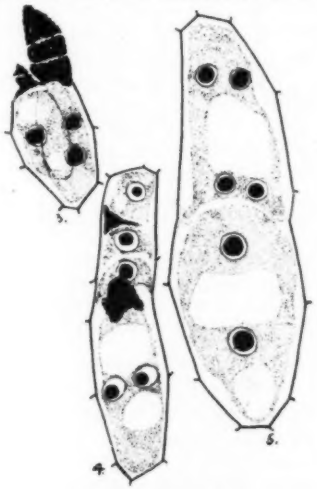
Figs. 1 & 2.

The archesporial cells cut off parietal cells and later are found deeply situated in the nucellus. Most of them degenerate, and the functional megaspore mother cells are easily recognizable by their large size and big nuclei (*Melia*, Fig. 2).

After the meiotic divisions, a linear tetrad of cells is formed in *Melia* while *Cipadessa* shows a T-shaped Tetrad of which the chalazal megaspore develops into the embryo-sac (Fig. 2). It is interesting to find in *Melia* any member of the tetrad irrespective of its position becoming the functional megaspore.

Though only a single megaspore functions to give rise to the female gametophyte ultimately, cases have been seen where two of the megaspore mother cells develop simultaneously.

In *Melia*, Fig. 3 shows two megaspores, one developing into a two-nucleate embryo-sac and the other into a uni-nucleate one. Fig. 4 shows a linear tetrad and a binucleate embryo-sac each having developed by different megaspore mother cells. Fig. 5 shows one developing into a four-nucleate embryo-sac and the other into a binucleate one. Finally



Figs. 3, 4 & 5

only one embryo-sac is found in each ovule, the others degenerate gradually.

In *Cipadessa* two megaspore mother cells have been found to develop up to the first meiotic changes.

The mature embryo-sac is typically eight nucleate in both *Melia* and *Cipadessa*. In *Melia* the micropylar end is broad and the antipodal is narrow (Fig. 6). The synergids are equal to the egg in size which is situated

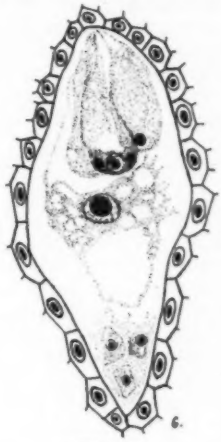


Fig. 6.

between them and take a dark stain. The polar nuclei have already fused producing a large fusion nucleus and antipodals show signs of degeneration.

The same holds good in the case of *Cipadessa* also except for the fact that the synergids are more massive and beaked. Unlike *Melia* the identity of the two polars are not still entirely lost in the fusion nucleus. The antipodals here also show signs of degeneration (Fig. 3).

Melia.	*Cipadessa.*
Fig. 1. × 450.	Fig. 1. × 630.
Fig. 2. × 450.	Fig. 2. × 900.
Fig. 3. × 900.	Fig. 3. × 900.
Fig. 4. × 900.	
Fig. 5. × 900.	
Fig. 6. × 900.	

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November 1936.

Deciduous Sessile Spikelets in Sorghum.

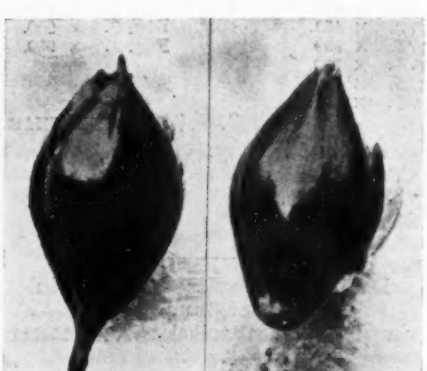
IN cereals persistent spikelets are a necessary economic equipment. An absence of deciduous spikelets characterises economic varieties; but the degree of persistence might vary. Deciduousness is a characteristic of the wild relations of cultivated cereals. This deciduousness may be of two kinds. In *Aegilops*, *Avena*, *Hordeum*, *Secale*, and

Triticum[1] spikelets shed owing to the fragileness of the rachis which snaps off and sheds down the spikelets with bits of rachis attached. In Rice[2] there occurs a shedding of the spikelets alone, consequent on the formation of callus at the place of articulation.

In sorghum with its usual single stalks and single heads, the problem of shedding is a serious handicap in economic varieties. Most cultivated sorghums are devoid of this defect so that persistent spikelets are the rule. The spikelets of sorghum are pedicelled or sessile. Pedicelled spikelets do not usually bear grains. In most cultivated varieties pedicelled spikelets are deciduous but in some they persist. This character has been used by Snowden[3] to differentiate varieties. Deciduous sessile spikelets are confined to wild sorghums (series *Spontanea*). In *Sorghum halepense* (Linn.) Pers., *S. arundinaceum* Stapf., and *S. virgatum* Stapf., the sessile spikelets drop off due to callus formation at the articulation between the pedicel and the base of the spikelet. In *S. sudanense* Stapf., the pedicels snap. This character of shedding through callus formation of the snapping of pedicels has been used by Coleman[4] to help farmers in Australia to separate *S. halepense* from *S. sudanense*. Snowden[3] records the fact that in Africa the wild races with shedding spikelets freely intercross with cultivated varieties. He refers to the practice prevalent among the farmers there, of vigilance in the eradication of such natural crosses. One of these wild African shedding types M. S. 1484 was received at Coimbatore through the courtesy of Kew. This type was like cultivated sorghum till heading and betrayed its wildness only at the milky stage when the sessile spikelets started shedding. At maturity all the pedicelled spikelets had shed and of the sessile spikelets all but a few had done so. The pedicels of the shed spikelets had a cup-like depression at their ends into which the base of the spikelets had fitted (*vide* illustration). An examination of five earheads showed that from 7 to 12 per cent. of the sessile spikelets remained attached to the earhead. The rest had shed. This habit of shedding persisted in the next and subsequent years. In the year 1934 natural crosses with neighbouring cultivated varieties were spotted among the wild population. These crosses had persistent spikelets. Three of these were sown and all of them segregated as follows :—

Selection No.	Spikelets	
	Non-shedding	Shedding
A. S. 3988 ..	.. 46	14
,, 3989 ..	.. 69	22
,, 3990 ..	.. 53	18
Total (observed)	.. 168	54
Calculated 3 : 1	.. 166.5	55.5
$X^2 = \cdot 054$	$P > 0 \cdot 8$	

It will be noted that the shedding character has proved a simple recessive to the non-shedding character. The gene responsible for shedding has been designated *sh*. *Sh* produces the normal non-shedding sessile spikelets. *Sh* is a simple dominant to *sh*.



Persistent Deciduous

Sorghum Spikelets

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B. W. X. PONNAIYA.

Millets Breeding Station,
Coimbatore,
September 24, 1936.

[1] Matsuura, H., *A Bibliographical Monograph of Plant Genetics*, (1900-29), 1933.

[2] Yoshito Yamasaki, *Jap. J. Bot.*, 1928, **4**, Abs. 354.

[3] Snowden, *The Cultivated Races of Sorghum*, 1936.

[4] Coleman, *Queensland Agrl. Jour.*, 1936, **45**, 602.

Albinism in *Eleusine indica* Gaertn.

THE occurrence and inheritance of albinism in ragi, *Eleusine coracana* Gaertn. have been reported.[1] Two factors C_1 and C_2 either alone or together are responsible for production of chlorophyll on the plant. A similar experience has been met with in *Eleusine indica* Gaertn. In some importations of ragi (called the African millet) from Africa, there were mixtures of *Eleusine indica* plants. A number of these plants were isolated and grown. Of these seven threw albinos. Counts taken showed that in every case there was an approximation to the 15 : 1 ratio of greens to alibnos. One of these families E. I. 1 gave 167 greens and 11 albinos. All the albinos naturally died after about the tenth day. Forty-eight selections were carried forward from among the greens. Of these twenty-two gave green seedlings only. Twelve families segregated and gave a 15 : 1 ratio of greens to albinos (actual 1230 : 83). Fourteen families segregated and gave a 3 : 1 ratio of greens to albinos (actual 1904 : 643). These figures prove the existence of two factors responsible either alone or together for the production of chlorophyll in *Eleusine indica* also.

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Millets Breeding Station,
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October 8, 1936.

[1] *Indian Jour. Agr. Sci.*, 1931, I (V), 569–76.

A Note on the Pistillody in *Hibiscus syriacus*, Linn.

PISTILLODY of the floral parts like sepals, petals, stamens and even ovules is of general occurrence among the Angiosperms, and several instances of the kind have been on record.[1] Dr. Agharkar has reported a case of pistillody of the stamens in *Hibiscus esculentis* in 1925,[2] wherein he has stated that the pistils have open ovary with one or two ovules, a well developed style and stigma. Recently several flowers of *Hibiscus syriacus* have been observed to exhibit this phenomenon of pistillody (Fig. 2); but whether these are cases of pistillody of the stamens is difficult to state on account of the unusual position of the pistil on the column. *Hibiscus syriacus* has got a staminal tube in the flower, upon which stamens are found in whorls right up to the end. The staminal tube itself ends in five

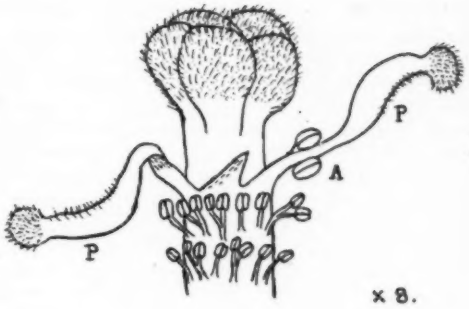

FIG 1.

Terminal portion of the column of *H. syriacus* showing clearly the lobes of the staminal tube and the point of origin of the pistils. × 8.

tooth-like lobes just below the stigmatic branches, sometimes even touching them. Some of these lobes ranging from one to three in some flowers were found to resemble pistils, not of the normal *Hibiscus* type but of the apocarpous type. The three regions of these pistils such as the ovary,

Fig. 2.

Photograph of the above showing three pistil and their position on the column. × 6.

style and stigma can be made out very distinctly. On account of their close proximity to the stigmatic lobes of the flower, they appear to arise from the base of the stigmatic lobes. In all the cases of pistillody

of the stamens that have been recorded so far, such pistils have replaced a functional stamen on the column. In the present case, the position of the pistil is different, and it does not replace a functional stamen. Further, in some cases, the pistil appears to be clearly a continuation of the connective of a stamen (Fig. 1). The pistil in these instances, possesses two functional anthers on two sides at its base. All the pistils observed so far, have ovaries of the closed type without ovules.

As suggested before, this peculiar case of pistillody cannot be considered as pistillody of the stamens for reasons stated above. There is, on the other hand, sufficient evidence to consider it as the lobes of the staminal tube modified unto pistils, with mono-carpellary unilocular ovary. In Fig. 1, two of the five lobes of the staminal tube are modified into pistils, the other three remaining quite normal and unmodified. Further, the lobes of the staminal tube can develop functional stamens on their surface, sometimes even though they are otherwise modified. The fact that in Malvaceæ, each stamen splits into halves each bearing a unilocular anther[3] eliminates the other possible explanation from consideration, *viz.*, the pistil to be taken as the modified connective of a stamen situated on one of the lobes of the stamenal tube.

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Department of Botany,
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December 4, 1936.

[1] Masters, M. T., *Pflanzen Teratologie*, 1886.
[2] Agharkar, S. P., Abstracts of Papers, *Ind. Sci. Cong.*, 1925, p. 108.
[3] Goebel, K., *Organography of Plants*, Eng. Ed., 1905, pt. 2, p. 536.

Notes on Floral Monstrosities in Maize (*Zea mays* L.).

MAIZE is a very plastic crop displaying a great variety of abnormalities already recorded by several workers.[1, 2, 3] Among the cultural lines, last year certain interesting cases have come to notice, two of which are of special interest, because as far as is known, they do not seem to have been described before. Therefore, a short illustrated note has been appended in each case.

SPECIMEN NO. 1.

In one cultural line about 50 per cent. of the plants presented an unusual kind of abnormality. Such plants terminally bore tassels of a peculiar nature (Fig. 1) bent in a downwardly direction in the form of an S and were prominently marked by the absence of husks. The flowers in the spikelets of these tassels were all found to be hermaphroditic. The majority of them had fertile gynœcia but abortive stamens. Only towards the distal end (as indicated by an arrow in Fig. 1) of the tassel, the situation was just the reverse, *viz.*, the gynœcia were abortive and the stamens were fertile possessed of normal viable pollen grains. The number of stamens, whether fertile or abortive, was three in each flower. At a later stage, however, normal well developed balloon-shaped grains were found to have been developed on the peculiar tassel described (Fig. 1). At the same time it is interesting to note that the cobs situated laterally on plants bearing such tassels externally looked quite normal but on removal of husks, they were found to be completely devoid of kernels or vegetative buds.

Fig. 1.

Zea mays L. A downwardly bent "Tassel" showing the well-developed grains. × 1/3.

Seeds from such abnormal plants have, during the present season, given rise in most

cases to plants bearing abnormal tassels of exactly a similar nature as observed in the preceeding season. This shows that the phenomenon described is genetic and is heritable as a dominant character in a similar manner as known in certain maize with "*tassel-seed*."[4]

Since this was written my attention was drawn to the excellent work of Eyster, where he describes[5] a more or less similar type of abnormal tassel designated as "*tassel-seed*" which has been figured and described as bent in a downwardly direction (not like an S) alone with a complete absence of staminate flowers. Moreover, he does not at all describe the condition of the lateral cobs on the plans bearing the "*tassel-seed*".

Fig. 2.

Ibid. A head-like cob showing an aggregati on of vegetative buds. The downwardly hanging leaves are the husks (H). × 1/2.

SPECIMEN NO. 2.

In another cultural line five plants were found to bear laterally headlike globular cobs (Fig. 2), possessed of 8–10 husks (Figs. 2–3 H), arranged in two gropus (of 4–5 each) on either side forming an imperfect covering. On closer examination after the removal of the husks, it was found that the axis of the cob was shortened (Fig. 3 A) bearing a number of vegetative buds (Fig. 3 B) in place of grains. There

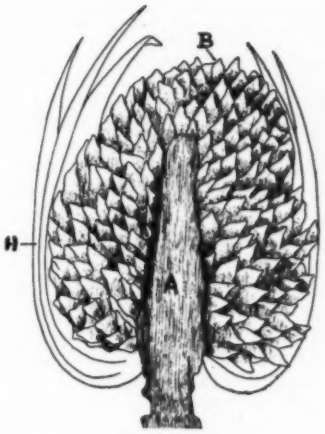

Fig. 3.

Ibid. The same head (as figured in Text-Fig. 2) in longitudinal section showing the shortened axis (A) together with numerous buds (B) and the husks (H). × 1.

was, however, no vestige of the essential organs left in them. The individual buds had a growing apex surrounded by small foliage leaves. The case appears to be an extreme one of a complete proliferation of reproductive spikelets into potential vegetative shoots.

Eyster has described an abnormal cob approaching the condition described presently But in his specimen there is a complete absence of husks, and the spikelets are usually completely sterile with greatly enlarged glumes.[6] Nowhere does he make a reference to the remarkable presence of vegetative buds as seen in my specimen.

I am very much indebted to Dr. T. C. N. Singh for useful suggestions and helpful criticisms and to Rao Bahadur G. N. Rangaswami Ayyangar, Millets Specialist, Coimbatore, for drawing my attention to Eyster's work.

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Sabour,
October 10, 1936.

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[1] Burtt-Davy, J., *Maize, Its History, Cultivation and Uses*, 1914, pp. 78-113.

[2] Schaffner, J. H., "Sex reversal and the experimental production of neutral tassels in *Zea mays*," *Bot. Gaz.*, 1930, **90**, 279-98.

[3] Eyster, W. H., "Genetics of *Zea mays*," *Bibliographica Genetica*, 1934, Deel **11**. (See bibliography on pp. 330-53).

[4] Types of maize having lateral and terminal inflorescences bearing exclusively pistillate flowers. (Emerson,

R. A., "Heritable characters of maize II—Pistillate flowered maize plants," *Jour. Heredity*—1920, **11**, 65–76; Phipps, I. F., "Heritable characters in maize XXXI—Tassel Seed$_4$," *Jour. Heredity*, 1928, **19**, 399–413.

[5] Eyster, W. H., *Ibid.*, 1934, 221-22, 57–258, figs. 17 and 60.

[6] Eyster, W. H., *Ibid.*, 1934, 264, Fig. 69.

The Antennæ of Aleurodidæ.

OBSERVATIONS on the adults of white flies have revealed a diversity of structure with regard to their antennæ, uncommon among other families of Rhynchota. The commonest form of the antenna is a filamentous structure consisting of seven more or less imbricate segments bearing fringed sensoria and spines. The general arrangement of these sensoria and spines is fairly uniform. Thus in most species there are two sensoria and a spine near the distal end of the third segment; a single sensorium at the distal extremity of the fifth segment; a spine about the middle of the sixth segment; and a sensorium with a spine on the distal half of the terminal segment (Fig. 1 *a*). Deshpande[1] has observed a more or less similar arrangement among the British species studied by him.

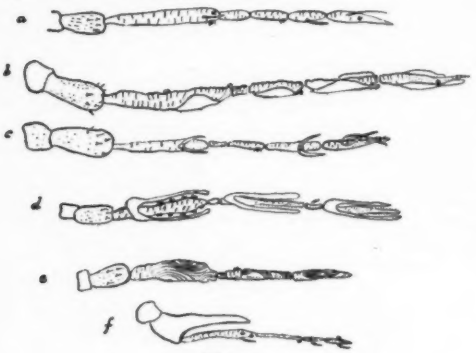

Fig. 1.

Some Indian species show a considerable deviation with regard to the form and arrangement of these sense organs on the antennal segments. To mention a few instances, in *Dialeurodes eugenii*, Maskell,[2] there are the usual sensoria, but the spines are completely absent, being replaced by conspicuous, transparent, tubular structures opening at both ends. The arrangement of these curious sense organs is shown in Fig. 1 *b*. In *Dialeurodes trilobitoids*, Q and B, the spines are paired and blade like, each pair arising from the same base; these being present on the third, sixth and seventh segments (Fig. 1 *c*). In the males of *Aleurotrachelus cærulescens*, Singh, the sensoria cover the major portion of the third, fifth and the seventh segments, and the elongated spines appear to form a sort of protective covering for them (Fig. 1 *d*). Among the males of *Aleurocanthus longispinus*, Q and B, the corresponding segments are without spines, instead of being furnished with a complicated series of grooves and ridges, the arrangement of which is shown in Fig. 1 *e*. Lastly in *Aleuroclava compler*, Singh, the second segment of the antenna of the male is highly modified, the third segment arising near about its base (Fig. 1 *f*).

In certain cases these structures are far more developed in one sex than in the other; and in nature males have often been observed rubbing their antennæ against those of a female prior to copulation. In such cases there is the probability that they function to stimulate the other sex. A detailed investigation on these structures is being undertaken to see if it can throw some light on the causes of these prominent structural differences.

The classification of the group is so far principally based on the characters of the pupa cases, as the adults are known in comparatively very few cases. In the light of the above observations, it is obvious, that the classification of the family will need a drastic revision, when based on the morphological characters of the adult, including the structure of its antenna.

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Nagpur,
October 6, 1936.

[1] *Trans. Roy. Ent. Soc.*, 1933, **81**, 118.
[2] *Mem. Dept. Agric.*, 1931, **12**, 25.

On Certain Abnormalities in the Sacrum of *Rana hexadactyla*.

THE iliosacral attachment in the Anura shows some variations, although in general the 9th vertebra acts as the sacral. According to Gadow,[1] *Pelobates* has two sacral vertebræ, the 10th and the 9th, a condition which is generally regarded as the most primitive amongst the Anura. In *Pipa* the sacrum is formed by the 9th and the 10th vertebræ, whose diapophyses have fused into

extra broad wing-like expansions. *Paleobatrachus* shows a slightly more advanced condition, the iliosacral attachment being formed not only by the 9th and the 8th but also to a certain extent by the 7th as well. The most advanced state is found in *Hymenochirus* in which the ilium has progressed so far that it has effected its attachment with the 6th vertebra. The Ranidæ are said to be a very stable group, the iliosacral attachment in these forms being at the 9th.

In the material under consideration, we notice that the iliosacral attachment has progressed forwards from the 9th vertebra, though the articulation is at the 9th. This has been noticed in more than a dozen skeletons of *Rana hexadactyla* prepared for class use.

Fig. 1.

Ventral view, A = Exit for spinal nerve. Dotted line shows position of cartilage.

One of these, illustrated here, shows certain peculiarities, the urostyle near its anterior end having on its right side a small foramen, probably an exit for a nerve. Here evidently the 10th vertebra has not completely fused with the urostyle. The centrum of the 9th vertebra has completely fused with the urostyle behind, and with the centrum of the 8th vertebra in front. The exits for the spinal nerves between these vertebræ are quite clear and the diapophyses are wide apart. The anterior end of the centrum of the 8th vertebra does not show a clear articular surface—this as well as the posterior end of the 7th being very rough, showing thereby a tendency for fusion. The 6th and the 7th vertebræ have their centra well fused. Their diapophyses are situated very close together, thus reducing considerably the size of the foramina for the spinal nerves. The ilia project far in front of their articulation with the diapophyses of the 9th vertebra. We have noticed, that in the dried skeletons the cartilaginous ends of the ilia shrivel up, so that if we allow for the cartilaginous pieces in continuation of the anterior ends of the ilia, the iliosacral attachment will be seen to approach very close to the diapophyses of the 8th vertebra.

This forward movement of the iliosacral attachment has been observed by us, as already stated, in a large number of skeletons prepared in the laboratory. Further examination is being conducted to see if this is a tendency towards racial change.

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December 4, 1936.

[1] H. Gadow, *Camb. Nat. Hist.*, **8** (Macmillan & Co.).

Annual Recurrence of Rusts in Eastern Russia.

By B. B. Mundkur.

(Imperial Agricultural Research Institute, New Delhi.)

IN regions where barberry is rare and *Thalictrum* is not as a rule attacked by *Puccinia triticina* Eriks. et Henn., the question of annual recurrence of stem and leaf rusts of wheat is rather complex. Urediospores being short lived and teliospores unable to infect wheat directly, investigators have looked for foci for infection in regions where either barberry and *Thalictrum* are normally attacked or where self-sown wheats occur on which the rusts can over-summer or over-winter as the case may be. Dr. Mehta's investigations conducted under the auspices of the Imperial Council of Agricultural Research have thrown considerable light so far as conditions for annual recurrence in India are concerned. In the Amur region of Eastern Russia, the question seems to have attracted the attention of phytopathologists for some years and a report published in 1927 by Miss A. A. Shitikova-Roussakova (*The Question of how rust infection is introduced into the Amur Region. Material for Mycology and Phytopathology.* Leningrad, **6**, 1927, 13–47) in Russian has recently become available to the writer in translation. For the benefit of rust workers in India, her conclusions are given below where it will be noted that conditions for annual recurrence of rusts on wheat there, are not dissimilar to those existing in India.

Miss Shitikova-Roussakova's conclusions are:

1. Foci for the renewal of stem and leaf rusts in spring do not exist in the Amur region because :
   - (*a*) Owing to severe and snowless winter, only spring wheats are sown, for which reason the rusts do not overwinter either as mycelium or as spores on the autumn-sown wheats.
   - (*b*) Indigenous barberry is met with to such an inconsiderable extent that it does not enter into consideration as an alternate host in causing spring infection with stem rust.
   - (*c*) Although native species of *Thalictrum* are fairly widespread, they cannot ordinarily, owing to dry conditions in spring, be assumed to be the initial cause of infection with brown rust but may only be regarded as a factor serving to enhance the infection in the course of summer.

2. According to the data of 1926 the part played in spring by the alternate hosts (barberry and *Thalictrum*) in renewal of rust in the area of the Amur Experiment Station is very small; there is no barberry and the local æcidial stage on *Thalictrum* develops very weakly in the conditions of drought of 1926.

3. In North Manchuria there exist foci of over wintering rust, from which the latter are introduced by northern wind. The first wave of introduction of leaf-rust and of its infection of the local wheats is indicated as having occurred between the 21st and 22nd of June. The first wave of introduction and infection of stem-rust should be referred to the interval between the 10th and 12th July when winds were blowing from the south.

4. In 1926 the introduction in the area of the Amur Experiment Station of the spores of stem- and leaf-rusts from the wheat-growing districts of North Manchuria was slight owing to the exceptionally severe drought there.

Only after the lapse of one month from the initial importation from the south (namely at the end of July) did the urediospores of *P. triticina* begin to be carried in large numbers by northerly wind: this fact is easily explained by the frequent rain in localities further to the north and by the more intense development there while in the south—in North Manchuria—drought was still persisting and wheat harvest had begun much earlier.

5. Under the condition of drought in 1926, the flight of urediospores of *P. triticina* and *P. graminis* Pers., was small in comparison with that of spores of other species.

6. A sharp increase in the number of spores in the air coincided with the time when all the plants were diseased with an intensity not below 3·25 of the 5 marks scale.

7. The maximum intensity of the flight of the spores of *P. triticina* (as a result of the greatest development of rust locally) occurred at the period of 'waxy' maturity of the grain and the numbers fell off sharply towards the time of harvest owing to the drying of the leaves.

8. The maximum flight of spores of *P. graminis* occurred on 9th and 14th August after which the number of spores sharply

decreased in connection with the beginning of harvest.

9. The late dates in the Amur region of sowing oats which are usually heavily infected with stem rust causes a rise in the curve indicating the intensity of the flight of spores during the autumn months.

10. According to the observations in 1926 the largest number of spores in the air occurred at a height of 2 to 4 metres but closer to 4 metres.

11. The presence in the air of a large number of teliospores of genus *puccinia* and their early appearance are interesting features peculiar to the Amur region and the Primorakaya province.

12. During the night the flight of spores is much less than during the day.

13. The number of spores suspended in the air followed a decreasing curve in the following order: *Helminthosporium*, *Alternaria*, *Ustilago*, urediospores of *P. graminis* and *P. triticina*, æcidiospores and teliospores.

A Note on the Rainfall of Kadur, Bangalore and Chitaldrug Districts in the Mysore State.

By N. Rajagopalan.

(*Indian Meteorological Office, Poona.*)

IN his studies on the rainfall of the Mysore State, Mr. Ananthapadmanabha Rao[1] has found a significant linear upward trend in the annual rainfall of Kadur District and an indication of secular trends in the case of Bangalore and Chitaldrug Districts. The data in each case extend over a period of forty years commencing from 1893.

The monthly rainfall data for these districts have been examined by the present writer with a view to find out if there is any linear trend in the monthly rainfall.

Monthly rainfall figures for the forty years were taken from the report on rainfall registration in Mysore.[2] The forty years' data were divided into two equal parts of 20 years each and the mean rainfall for the two periods found out. The months which showed comparatively large differences between these two means were then taken up for closer examination. It is seen that there are comparatively large differences between the means of the two periods in the months of July, August, September, October and November for the district of Kadur, August, September and October for the district of Bangalore and June and November for the district of Chitaldrug. The rainfall series for the above months were then expressed as linear functions of time x, *viz.*, $y = a + bx$, where y represents rainfall, a is a constant and b the regression coefficient. The equations with the values of t for the regression coefficients are given below:—

Months	*Equations*	t
	KADUR.	
July	$y = 18.14 + .30x$	1.92
August	$y = 10.38 + .18x$	2.09
September	$y = 5.39 + .04x$	1.02
October	$y = 4.80 - .05x$	1.17
November	$y = 1.85 + .04x$	1.40
	BANGALORE.	
August	$y = 4.83 - .036x$	0.92
September	$y = 8.17 - .067x$	1.46
October	$y = 6.18 - .037x$	0.88
	CHITALDRUG.	
June	$y = 3.29 - .045x$	3.21
November	$y = 1.06 + .055x$	2.04

From the values of t from the above table it will be seen that b, the regression coefficient, is significant for the month of August and approaching significance for the month of July in the district of Kadur, insignificant for the three months studied in the district of Bangalore and significant for both the months in the district of Chitaldrug.

The mean annual rainfall for Kadur, Bangalore and Chitaldrug are 71.87, 31.73 and 23.02 inches with the coefficients of variability 18.49 per cent., 21.0 per cent. and 23.40 per cent. respectively. The analysis of the monthly rainfall shows that the linear upward trend observed in the annual rainfall of Kadur may be ascribed to the increasing tendencies in the rainfall of July and August. For Bangalore, none of the months show any linear trend. The monthly rainfall of Chitaldrug shows a decreasing tendency in the month of June and an increasing tendency in the month of November.

The present investigation was made at the suggestion of Dr. R. J. Kalamkar to whom the writer's thanks are due.

[1] "A Note on the Statistical Analysis of the Rainfall of the Mysore State," by Mr. Ananthapadmanabha Rao.

[2] "Report on the Rainfall Registration in Mysore."

Imperial Agricultural Research Institute, New Delhi.

AN event of outstanding importance to the progress of Agricultural Research in India is the transfer of the Agricultural Research Institute from Pusa to New Delhi. As a consequence of the damage done to the Phipps Laboratory at Pusa by the severe North Bihar Earthquake in January 1934, the decision was taken to move the Institute to New Delhi. Instances of wholesale transfers of big Research Institutes like the Imperial Agricultural Research Institute are rare in the annals of research institutions, not only in India, but also elsewhere in the World and the authorities of the Institute have to be congratulated for the efficient manner in which they have handled the numerous difficult problems that must have beset them in this gigantic task. Their task was rendered all the more difficult by the unusually early break of rains in North-East India and the floods both in Bihar and Delhi which was a feature of the monsoon of 1936.

The Imperial Institute of Agricultural Research at Pusa was inaugurated 30 years ago and with the progress of time became famous in India and abroad as the "Pusa Institute". The Institute holds a proud and enduring record of achievements in the science and practice of agriculture. The transfer has enabled the location of the Institute now renamed "Imperial Agricultural Research Institute, New Delhi" at the Imperial capital, which is easily accessible to provincial agricultural officers, members of the Central and Provincial Legislatures, non-official visitors and visitors from abroad. The foundation stone of the Library Building was laid by H. E. Lord Willingdon on the 19th February 1935 and the Institute was declared open by H. E. Lord Linlithgow, on the 7th November.

The total area of the Institute is about 800 acres, of which about 275 acres are under buildings and pasture and the rest is agricultural land which has been laid out into fields for experiment and research. The buildings comprise a Students' Hostel, providing accommodation for 24 students, separate blocks for the agricultural, botanical, chemical, entomological and mycological sections and a spacious central building for the Library designed to accommodate two lakhs of volumes. The agricultural section situated towards the western boundary of the Institute, consists of two sets, one including a dairy cattle byre with modern fittings, a veterinary dispensary, etc., devoted entirely to the maintenance and development of the pedigree Sahiwal herd. The other set of buildings consist of bullock byres, godowns, a workshop, etc. The main farm area is 475 acres in extent in a compact block for cultivation and field experiment.

In the Botanical section, laboratories have been provided for researches in physiological botany and cytology. In the Chemical section, a laboratory has been equipped for carrying out small-scale investigations on the utilisation of agricultural wastes and products and for devising ways and means for the production of intermediate products from agricultural produce. The necessity for such a laboratory was recognised fifteen years ago by the Board of Agriculture in India. The other features are the provision of a laboratory for nutritional studies relating to the differential composition and nutritive value of the different types of crops and the effect of soil conditions and treatment on the composition and nutritive value of cultivated crops. In the Entomological section facilities have been provided for the study of parasitology. In the Mycological section, there is a large insect-proof house, part of which consists of glassed incubicles for carrying out pot culture experiments.

Post-graduate work at the Institute at Delhi will be carried on with the object of stimulating advanced research in agricultural sciences. The Government of India have recently issued orders that those who have satisfactorily completed the course in any of the subjects, or who may do so in future, will be regarded as Associates of the Imperial Agricultural Research Institute and may affix to their names the abbreviation "Assoc. I. A. R. I."

REVIEWS.

Inorganic Chemistry: A Survey of Modern Developments. By Sir Gilbert T. Morgan and Francis Hereward Burstall. (W. Heffer & Sons, Ltd., Cambridge.) 1936. Pp. 462. 15*s*. net.

This is a most refreshing and remarkable book which no student of chemistry—a category taken to include also teachers of the subject—can afford to ignore. While displaying great variety and wealth of detail it is not a text-book, but rather, as implied by the sub-title, a large-scale picture of inorganic chemistry as it stands at the moment. Excepting fundamental matters required to introduce a chapter or a section, therefore, it deals only with recent events, specific reference to those earlier than the 1920's being rare, and to those in the 1930's very numerous, including many dated 1935.

Such organic chemists as have experienced a difficulty in piloting their course among the shifting sands of modern atomic theories will find the book particularly attractive and helpful. This arises in part from the lucidity with which these theories are unfolded by the introduction, and also because the share taken by carbon compounds in developing modern inorganic theory and practice is constantly brought to mind. Arrangement is based on the periodic system, and before reaching the main groups two chapters deal respectively with the key elements, or zero group, and the isotopes of hydrogen, leading to heavy water. The latter is a valuable synopsis of deuterium chemistry, and will evoke speculation on the bewildering possibilities of deuterorganic chemistry.

In passing through the groups, ample reference is made to co-ordination compounds, as might reasonably be expected from the numerous original observations in this field which we owe to Sir Gilbert Morgan and his collaborators. These are based on the co-ordination and chelate phenomena explained in the introduction as arising from Werner's theory; and have constituted the most potent factor in fusing the organic and inorganic branches which has operated since Wöhler's classical discovery cut them apart. General interest will be taken also in the sections on hydroborons, the rare earth metals, siloxen, hafnium, nitrogen, rhenium, ruthenium, cobalt, nickel and platinum, embracing the most recent information thereon.

Having disposed of periodic groups, the authors devote a long and valuable chapter to the transmutation of elements depending on (1) spontaneous disintegration, (2) artificial disintegration and (3) induced radioactivity. Here will be found profitable information concerning the positron, the neutron, the proton, the hypothetical neutrino and various radiations together comprising the primordial stuff common to all elements. It includes a survey of the uranium, thorium and actinium series of elements undergoing radioactive change, and a long section on induced radioactivity summarising the most recent observations of Curie, Joliot, Fermi and others in this field, with a description of the methods by which artificial transmutation is detected and measured. A fairy-story transformed into reality. Then follows a review of co-ordination compounds in nature, the arts and industries, a special feature of which is the section devoted to their applications in qualitative and quantitative analysis. These have been surprisingly useful over a wide range of metals connected with all the periodic groups, the sensitivity of some colour-tests being almost incredible: one part of copper in one hundred millions, for instance, is detected by sodium diethylcarbamate, and quinalizarin reveals one part of beryllium in ten millions.

The later chapters deal with corrosion of metals, intermetallic systems involving the question whether these are strictly compounds in the modern sense, metallic carbonyls, nitrosyl compounds and finally, organic derivatives of metals and metalloids, covering mercurials, silicanes, germanes, stannanes, arsenicals, antimonials, bismuthines, with carbon compounds of selenium and tellurium, all fully discussed in the light of most recent researches. It forms a becoming conclusion to a work evidently directed to harmonising the carbon with non-carbon fields, and maintains a feature common throughout, namely, unusual care in preparation for the press. This point merits particular praise, because the treatise amplifies three lectures delivered by Sir Gilbert Morgan as recently

as 1933 ; and yet the proof-reading gives no indication of haste. In fact, the only improvement that can be suggested for future editions is an expanded index.

The foregoing comments will show that chemists now have access to a presentation of chemistry in an eminently unified form. The explanation lies in the fact that throughout his auspicious pursuit of the subject Sir Gilbert Morgan has divided his attention impartially between the two classical branches, and has remained an unflagging devotee of the laboratory ; moreover, he has been fortunate to enlist an enthusiastic partner so highly competent as Mr. Burstall.

M. O. F.

Custom is King.—Essays presented to R. R. Marett on his Seventieth Birthday, June 13, 1936. Edited by L. H. Dudley Buxton. (Hutchinson's Scientific and Technical Publications, London.) 1936. Pp. 325. Price 12*sh.* 6*d.* net.

This commemoration volume comprises nineteen essays contributed by Dr. Marett's old pupils and colleagues and presented to him on the happy occasion of his seventieth birthday. The editor has written a brief but excellent account of Dr. Marett's academic life in the first chapter, besides an essay on " The Sea Raiders " which deals with the physical characters of the various invaders who have left marks of their settlement or of their destructive propensities in Oxfordshire. The problem of Buxton is to investigate what kind of man was living in Oxfordshire in Anglo-Saxon times, and was he definitely allied in physical type to the Romano-Britons. The conclusion reached is that the burials of Anglo-Saxons contain two closely allied types of man, one of Continental type, probably pure-blooded invaders, the other more closely akin to the Romano-Britons. It must be remembered that students of history and archæology differ in regard to their views as to the survival of older folk : one school pointing to a fairly complete break at the period of the Saxon invasion, and the other refuting such a break.

In a brief review of this excellent book, we can select only a few essays for comment, without in any way implying that others not chosen for such a purpose are either uninteresting or unimportant. We have read them with great enthusiasm and each essay dealing with a special field of anthropology presents a complete account of the topic.

Anthropology, like other sciences, suffers from specialisation, when it forgets man the animal, and devotes attention to his skull, or his arts and industries or his social customs and manners. "The function of the anthropologist is to interpret man in his entirety—not piecemeal." Earnest Hooton's essay on the "relation of physical anthropology to cultural anthropology" is a powerful plea for a synthesis of these two studies. We entirely agree with the author when he points out that physical anthropology is not a study which can be pursued profitably with utter disregard to its sociological connotation.

The prehistory of the Canadian Indians is another interesting contribution by Jenneso. At the time the French landed at Quebec, they found that the country was occupied by nearly fifty tribes, differing in language and customs, though each tribe was self-supporting. This diversity militated against any serious resistance to European penetration, and has given rise to administrative problems which would not exist, had Canada been inhabited by a single people. These tribes bear strain of many races in their blood. The Mongoloid and Melanesian affinities are traceable among some, and in others those of the white race, which may have spread across Northern Asia during the retreat of the ice sheets. Among these well-defined tribes, the Iroquoian people alone displayed any real talent for political organisation, derived perhaps from their European contact. The principal feature of this organisation was to subordinate village communities to tribal units and to confederate tribes into nations, governed by representative councils and guided by truly democratic ideals.

The book is full of other interesting articles. It seems to us that every cultivated person has an innate interest in the study of anthropology and the book introduces the reader to the rich and varied stores of knowledge concerning the physical and social evolution of the race. The essays form a noble tribute to the genius of a great teacher whose zeal inspired his pupils and whose contributions have enriched the science which he taught.

Ergebnisse der Enzymforschung. Edited by F. F. Nord and R. Weidenhagen. (Akademische Verlagsgesellschaft M. B. H. Leipzig.) Vol. IV, 1935, pages xii + 391, price RM 29; Vol. V, 1936, pages xi + 378, price RM 28·50.

During the past few years the volumes of "Ergebnisse" have formed an indispensable equipment to research workers who find in them a mass of information presented in an easily accessible form and treated in an authoritative manner.

The recent volumes have more than fulfilled the expectations of the students of Enzyme chemistry. They have maintained the high standard set up by the previous issues; they are international in character containing as they do contributions from the foremost workers in the various aspects of enzyme research, irrespective of nationality and are, in a sense, a collection of monographs. Particularly in a subject, in which the knowledge is in a state of flux the contributions of the type covered by the 'Ergebnisse', besides being stimulating and helpful to workers in their particular field of study will prove invaluable to crystallise the momentary position in the various branches and correlate it with advances in other fields.

The fourth volume contains a stimulating article by Henry Borsook on the application of the second law of thermodynamics to the study of enzyme systems. This is followed by a contribution from Henry Tauber on the activators and inhibitors of enzymes. The study of activations, has more recently emerged from its empirical stage and the precise information, now available is of great significance having proved useful in understanding the regulating and directing mechanisms elaborated by the organism: in some cases the study of the activating and retarding systems has thrown light on the nature of the active groups of enzymes and clarified, to some extent, our knowledge of their chemical nature. The activations caused by thiol compounds has been treated by Bersin in a separate article. Other articles are: Cholinesterase by Ammon; Intra-cellular regulation of enzyme-reactions, with special reference to amylase, by St. J. von Przylecki; Application of enzymes in Industry, the second part of which deals with the recent work on the rôle of enzymes in the baking industry by Hesse; Rennet and coagulation of milk by Maurice Beau; Intermediary products of the biological decomposition of carbohydrates by Meyerhoff; Bacterial sugar-fermentation by Kluyer; the biochemical changes during the curing of tobacco (drying and fermentation) by Bodnár and Barta; Animal Dehydrogenases by Harrison; Lactoflavin and enzyme-precursors by Shibata; and Luciferase by Newton Harvey. The volume is provided with a good author index and each individual contribution is provided with a comprehensive bibliography. It is needless to say that in a volume so carefully planned and got up, there can hardly be any error; it is, therefore, surprising to find that on page 29, in the contribution dealing with reversible and reversed enzymatic reactions, it is stated with reference to vitamin C that the "evidence of the existence of this vitamin *in vivo* in a state of partial oxidation, associated with its autoxidisability and its reduction by enzyme metabolite systems, makes it seem highly probable that one of the functions of the substance is to serve as a compliment to incomplete enzyme centres." All existing evidence shows that the autoxidised vitamin C has little physiological significance and only in its partially oxidised state as dehydroascorbic acid is it capable of being reduced to the original state; further no enzyme-metabolite system has been discovered which reduces dehydroascorbic acid, although the existence of such a system has so often been assumed.

Volume V, that appeared more recently comprises 12 contributions, six of them dealing with the enzymes, proteases phosphatases, lacithinases, pectases, glucose oxidase and polyphenol oxidase. There are reviews on recent investigations covering chlorophyll photosynthesis, synthesis of fat from carbohydrates, asymmetric synthesis, optical specificity, autolysis and a contribution dealing with the application of nephelometric technique to enzyme research. Prof. McKenzie's article dealing with asymmetric synthesis is of special interest in view of the biological significance of such syntheses. Among the asymmetrases are *l*-oxynitrilese which brings about the formation of (-)mandelonitrile from benzyldehyde and hydrogen cyanide, carboligase, extensively studied by Prof. Neuberg and ketonaldehydemutase. The section on proteases has been contributed by Grassmann and Schneider and deals with the methods of preparation, purification and isolation of proteases and peptidases. A critical discussion on the nature of proteases and the problems of specificity and mode of

action is included in the contribution. Folley and Kay have given an excellent resume of the recent work on phosphatases which are concerned with the formation and biological functioning of a variety of subtances such as phospholipins, phosphoric esters of carbohydrates, phosphoproteins, phosphocreatine and phosphoarginine, the nucleic acids, etc. Prof. Kertesz has discussed the recent researches on the pectic enzymes, a group which has not received adequate attention; the pectinase complex comprises several specific enzymes such as polygalacturonase, pectin-methoxylase, and arabanase. The author considers that there is need for a comprehensive study of the components of the pectase-complex. The synthesis of fats from carbohydrates has been dealt with by Ida Smedley-Maclean. The production of fats from glycerol and fatty acids is brought about by lipases; the probable mechanism of the production of glycerol is through the decomposition of glycerophosphoric acid produced in the anærobic decomposition of hexose, by a phosphatase; the various theories regarding the production of fatty acids from carbohydrates have been critically examined and the author concludes by saying that the "sum of available evidence at present is probably more in favour of a fatty acid being formed from hexose through the intermediate stage of pyruvic acid than of its formation either directly from hexose or through the intermediate stage of acetaldehyde, but the nature of the steps by which the synthesis is brought about is still to be elucidated." Perhaps the recent technique for the study of intermediary metabolism introduced by Schoenheiner and Rittenberg (*J. Biol. Chem.*, 1935, **111**, 163-192) in which the ordinary hydrogen in the experimental material is replaced by heavy hydrogen and the fate of the altered molecule followed through the organism, may throw light on the problem.

The volumes provide stimulating study. Future annuals will be eagerly awaited.

Chemical Synonyms and Trade Names.—A Dictionary and Commercial Handbook. By William Gardner. (The Technical Press, Ltd., London.) 1936. Pp. 495. Price 31*s.* 6*d.*

In the course of a recent lecture delivered before the Chemical Society, the Editor of the *Journal of the Chemical Society* referred to the long-felt need for systematising the chemical nomenclature and the attempts that are now being made to arrive at an international agreement. While this has been the case even in systematic chemistry, in the designation of chemicals used in trade and commerce, there has been no rationalisation. The names give no clue, whatever, in many cases to their composition, resulting in a great deal of confusion. Some chemicals have been labelled by short names for convenience; others have been called by initials only and for yet others, fanciful terms have been employed. Chemists who have frequently to deal with the trade names of raw materials, pharmaceuticals, minerals, explosives, dyestuffs, alloys and commercial chemicals, should perforce resort to a suitable dictionary. It is difficult to imagine a relationship between the daffodil and cadmium sulphide and yet the term "daffodil" is applied to the pigment which is otherwise called cadmium yellow. There are also numerous instances where the same material is known by different names and this introduces a further complication to the chemist who should provide himself with a dictionary also giving synonyms. The Editor of the Chemical Society in the address, to which reference has already been made, mentioned instances where industrial names have invaded scientific literature; thus the terms *decalin* and *tetralin*, which are the names for decahydro-, and tetrahydronaphthalen, are frequently found in systematic chemistry. The term *thionessal*, which, by the way, is not found in the book before us, is 2 : 3 : 4 : 5-tetra phenyl thiophen. These few instances should be enough to show the value of a compilation of the type under review and chemists should be grateful to the author for having effectively lightened their trouble by providing chemical equivalents of trade names. The fact that the book under review is the fourth edition, shows that chemists have not been slow in realising its value. It contains no less than 25,000 definitions and cross references and is invaluable as reference book, not only to the chemists but also to the manufacturer and dealer. The appendix includes additional matter but the users of the book could have been saved the trouble of having to refer to two separate sections, if the entire matter had been classified alphabetically. This, we have no doubt, will be looked into while bringing out the next edition which, we are confident, the publishers will be called upon to undertake in the near future. The book covers a very wide field and will be

found indispensable to all those interested in chemical industries.

Outlines of Organic Chemistry. By E. J. Holmyard. (Edward Arnold, London.) 1936. Pp. xi + 467. Price 7*sh.* 6*d.*

The fact that since 1924 four reprints and a new edition have been called for, bears testimony to the usefulness and popularity of the book under review. In the 1936 edition large portions have been rewritten and, with exceptions (some of which are noted in the sequel), the material has been brought into line with the latest advances in theory and practice in so far as they may legitimately find a place in an elementary treatise. The historical introduction is fuller than usual, the author being specially qualified to write of this aspect of the subject. The book is readable from cover to cover and the many apt analogies (such as synthetic organic chemistry to a game with Meccano models and steric hindrance to the attempted entrance of a fat lady into a crowded bus) would serve to augment the interest of the beginner in a fascinating, but complex and confusing subject. The theoretical parts (*e.g.*, the chapters on tautomerism and stereoisomerism) are extremely lucid and an adequate account is given of the electronic conception of valency, but since this has become fundamental to the intelligent understanding of organic reactions more space devoted to it would perhaps not be disproportionate. A brief mention might also have been made of the newer physical methods of examining the structure of organic compounds, dielectric constants, the parachor, free energies and the Raman effect. Other sections requiring elaboration are the determination of m.p. and b.p. and microanalytical methods, the time not being far distant when the latter will largely supersede the classical macro procedures. A preliminary insight may also be profitably given into the mysteries of Beilstein-Prager-Jacobsen and Heilbron's Dictionary.

Among the matters of detail that are unsatisfactory, some may be mentioned. The structure of starch and cellulose are by no means "unknown"; nothing is said of modern methods for the dehydration of alcohol and of the fermentation methods for and uses of butyl alcohol; the now commonplace catalytic vanadium pentoxide oxidation of naphthalene to phthalic anhydride and the similar very interesting oxidation of benzene to maleic anhydride are serious omissions; The Diels-Alder reaction needs at least a passing reference even in an introductory volume; while conjugated double bonds are discussed, there is no mention of the technically important butadiene and isoprene; Haworth's name is not cited in connection with the ring structure of glucose; the statement (p. 340) that sucrose differs from glucose in charring with hot sulphuric acid is incorrect, as glucose also chars; the only (nor indeed the main) use for amyl acetate is not as a flavouring essence; all natural glucosides do not give glucose on hydrolysis; acetate rayon is not difficult to dye; diazo salts can be stabilised and in this form are commercial products; among the 200 or more names in the index of names Claisen finds no place.

A work of warning is necessary with regard to the prescription of the book as a text in our Universities. The book stresses the theoretical basis of the subject rather than the practical applications and in the hands of the already theoretically inclined Indian student it would lead to deplorable results unless supplemented by sound laboratory practice and incorporation in the lecture work of the technical aspects of organic chemistry. From this point of view some recent books by American authors deserve wider recognition in this country. K. V.

The Principles of Bacteriology and Immunity. By W. W. C. Topley, F.R.S., and G. S. Wilson. (Edward Arnold & Co., London.) Second Edition, 1936. Pp. xv + 1615. Price 50*s.* net.

We hardly know of any other book on bacteriology which gives a fuller treatment of the subject in all its aspects. The first edition was published in two volumes, and the attempt to combine them into one has swelled the size of the book altogether out of proportion to the conventional avoirdupois of text-books for undergraduate and post-graduate students. But the consolation is that they will find in one volume all the necessary information which recent investigations have added to our knowledge. The greatest merit of this encyclopædic work is that it is eminently readable and none of the blemishes usually associated with technical treatises is encountered in its perusal. We confess, however, that nothing less than the dreadful fear of an impending examination can persuade one to acquire mastery of 1,600 pages of closely printed matter. Having read the book

without the fear of dire consequences of a public examination, we feel that we have read one of the finest text-books, containing a clear, full and authoritative account in each chapter.

The contents of the book are divided into four parts. In these four parts the authors have brought together in the compass of a single volume a multiplicity of subjects which are invariably treated in numerous monographs. The first two parts are devoted to the consideration of the historical and general aspects of bacteriology and systematic account. Parts III and IV deal entirely with general and particular problems emerging from the application of the bacteriological principles to the study and control of infective diseases. These problems are presented in their biological aspects "as instances of variations in the relations of living things to each other, and to their environment, rather than as isolated problems of diagnosis, treatment or prevention, centring round a sick man or animal." The old barrier separating the research workers in human and veterinary science is rapidly breaking down establishing numerous contacts between them and "in no branch of medical science is the sterilising effects of the anthropocentric attitude more obvious than in the study of bacterial infection." The main objective of the authors in following this order of presentation is to provide the student with the knowledge that bacteria constitute a distinct class of organisms in their taxonomical and ecological relations and a knowledge of this department of bacteriological science is indispensable for a comprehensive understanding of their reactions with their hosts. In recent years many bacterial species have been studied solely from their pathological standpoint almost to the exclusion of systematic description. There are gaps in our knowledge of the systematic position of several species, and they have been bridged to the narrowest limits by the personal studies of the authors.

The book has excluded from its compass all detailed descriptions of technique, thus departing from the usual convention of combining practical instructions for laboratory work with the discussion of the general principles of the subject. This breaking away from the routine practice of text-book writers has given the present work a power enabling the reader to acquire a firm grasp of the subject-matter.

At the end of each chapter there is complete list of references to literature so as to afford facilities to the students to follow up for themselves any specific branch of study for fuller information. It is unnecessary to delineate the excellences of this sumptuous volume which is as full of information as it is authoritatively expounded. Bacteriology has interest not only to the medical profession, but it also has an important bearing on agriculture and other industries. A general acquaintance with the principle and the application of this important branch of biological science is almost an indispensable equipment of every cultivated person and the needs of such readers and those of specialists are met by this standard work. It is a monumental contribution to our knowledge of bacteriological science.

Principles of Structural Geology. By C. M. Nevin. (John Wiley & Sons, New York; Chapman and Hall, London.) Second Edition, 1936. Pp. 341. Price 17*sh.* 6*d.*

The second edition of this well-known text-book follows the same lines as the first, with the exception that a new chapter written by E. B. Mayo has been added on the structures associated with igneous intrusion. In common with *Structural Geology* by Willis, much of this book is devoted to a discussion of stress and strain relations, flexures, joints and cleavage; subjects that seldom receive adequate treatment in British text-books. Besides the new chapter mentioned above, the book also discusses structures in unconsolidated sediments, the nature of the earth's crust, continents, oceans and mountain systems. Clear type, good paper and excellent block diagrams, features that have long characterised the geological publications of John Wiley and Sons, give to this book a very pleasing appearance. The binding, however, is unsuited to a monsoon climate.

The book is intended for first year students and is concerned principally with structures in relatively undisturbed sediments. The influence of oil geology is seen in the excellent chapter on flexures. The author is less concerned with the problems of Archæan geology and with complex orogenic belts, in which the effects of metamorphism and violent tectonic movements preclude the deduction of simple causes from effects. Leaving aside these difficult areas of research, attention is paid to simpler structures, and a considerable part of the book is occupied

with the determination of the direction of causal stresses responsible for the formation of given strains ; whether they be manifested by joints, cleavage, faults or folds. Even in the case of these simpler structures, however, our understanding of stress-strain conditions is very limited. The author admits (p. 22) that unless it can be demonstrated that the causal stress is non-rotational, its exact direction is usually not determinable. So far as can be seen, however, no indication is given in this book of showing whether or not the stress is rotational. There are so many vicissitudes through which a rock may pass—tensional and compressional stresses, stresses varying in direction in the course of time (p. 58), former burial under a load of unknown magnitude and alteration in ductility,—that the number of inferences from a given deformation is large. This uncertainty is manifest in the chapter on joints (pp. 161–163) where four theories are tested on a single set of observations. It is seen also in the discussion of the stress, shear and strain theories of failure (p. 27). A realisation of this uncertainty is a valuable lesson to the student in caution, but it may be questioned if the qualifying clauses in the general trend of argument really teach it sufficiently. The value of the author's discussion is partly that the reader is taught to visualise structures in three dimensions, and partly that, as an outcome, the solution of certain practical problems, such as an indication of inversion from drag folds (p. 75), is suggested. A chapter of particular interest is that dealing with structures in unconsolidated sediments and the compaction of sediments. In a future edition it is to be hoped that this account will be amplified by a reference to the work of Kendal and Bailey on contemporaneous seismic disturbances. Under compaction of sediments the author stresses the geological results of loss in volume on consolidation. Differential compaction of muds deposited around a hill or chain that is later buried by younger strata results in the formation of supratenuous folds, in which there is a thinning of sediments over the crest of the buried structure. Such folds are considered to be directive in that later folding by compression tends to follow the lines of weakness already established by differential compaction.

In conclusion, this book may be recommended as giving a clear account of the deformation of the earth's crust. J. B. A.

Grimsehl's Lehrbuch der Physik.—Edited by R. Tomaschek. I Volume (Mechanics, Heat, Acoustics). 9th edition. 1936, Pp. 676, R. M. 19·80. II Volume (Electromagnetic field, Optics). 7th edition. 1936, Pp. 900, R. M. 26. III Volume (Matter and Ether). 7th edition. 1936, Pp. 430, R. M. 14. (Publishers : B. G. Teubner, Leipzig, Berlin.)

Grimschl's Lehrbuch der Physik edited by Professor R. Tomaschek is not new to the English-speaking students of Physics. This work has already become so popular that Messrs. Blackie & Son, Limited, London, have issued an authorised translation in a series of five volumes, the last volume of which has been published only very recently. The latest German edition of this work, which is in our hands, has been issued in three volumes. The first volume dealing with Mechanics, Heat and Acoustics being the ninth edition, while the other two volumes dealing with Electromagnetic field and Optics, and Matter and Ether are the seventh German editions.

A perusal of this work reveals the comprehensive nature of the undertaking. Even the subject-matter has been so arranged that the trend and continuity of thought have been kept up throughout. Another characteristic feature of this didactic masterpiece is the numerous illustrations (many of them being clear reproductions of actual photographs) which adorn almost every page. The advantages of such illustrations as an aid to the understanding of the subject-matter need hardly be stressed. Special mention must however be made of the beautiful photographs reproduced in the second volume illustrating the laws of Geometrical Optics. This has transformed the usually dry subject of Geometrical Optics into a very lively topic. As the editor himself remarks, the experimental facts are consistently kept in the foreground and the theory developed only so far as is needed to explain the experimental results. Another added feature is the inclusion of a set of tables containing Physical Constants and other relevant data which are of immense use to the student. The treatment has been uniformally good so that we cannot pick out any particular chapter as having been the best of the lot. The editor has tried to make the work as up to date as possible and considering the rapid pace at which scientific research is developing it is imperative that one or two

of the latest discoveries might have been omitted and it is not fair to criticise the work on that score.

Before concluding a word of praise must be given to the excellent get-up of the publication which is a characteristic feature of most of the German publications. We have no hesitation in recommending this work as a text-book in all colleges in which Physics is being taught. B. V.

A Text-Book on Astronomy. By H. Subramani Aiyar, M.A., Ph.D. (London). (Chitra Publishing House, Trivandrum.) 1936. Pp. 438. Price Rs. 6-12-0.

This volume, as explained by the author in his preface, has been specially prepared to meet the demand for an introductory text-book for the use of students taking a course in those portions of astronomy that are required for the B.A. and B.Sc. degrees in Indian Universities. Dr. H. Subramani Iyer is peculiarly fitted for the task of writing such a text-book, from his long experience as a teacher of astronomy in the college classes and also the Director of an old established astronomical institution. Astronomy is studied in most of our universities as a part of mathematics and hence the treatment in this book is, to a large extent, mathematical. The course well covers the academic requirements even up to the honours standard, the mathematical portions following closely the well-known treatises of Godfray, Ball and Smart.

The main part of the book is devoted to spherical astronomy and has many features to commend it. The principal facts are here presented in a clear and concise manner so that even readers with only a limited equipment of mathematical knowledge can understand the essential principles of the subject. The book opens with an introductory chapter dealing with the sphere where the fundamental formulæ of spherical trigonometry, required in the later chapters of the book, are derived. Chapters II to V deal successively with the Celestial sphere, the various systems of spherical co-ordinates, the figure of earth, the phenomena depending on the earth's diurnal rotation and its annual revolution round the sun. A brief introduction to the elementary principles of dynamical astronomy is given in Chapter VI which is followed by a chapter on time and the different systems of time reckoning. Chapter VIII is devoted to the various methods employed for finding local time and for determining the co-ordinates (latitude and longitude) of a place from observations. In the next four chapters, the important corrections to astronomical observations are discussed—*viz.*, Precession and Nutation, Aberration, Refraction and Parallax. The moon, the planets and their motions form the subject of the next two chapters. Chapter XV deals with the transit of an Inferior Planet across the sun's disc, which, it has to be observed though good as a mathematical exercise, now possesses little more than a historical interest. We have next an excellent chapter on Eclipses, but a fuller treatment of occultations and the methods of reduction would be desirable.

Passing on to the descriptive portions of the work (Chapters XVII and XVIII) we have to confess a feeling somewhat of disappointment. The account is too brief and does not form a well-connected story. Perhaps it is due to the fact that the author has attempted to condense an enormous amount of information on a growing subject within a space of thirty pages. The arrangement of matter in the chapter on "Stellar Universe" does not seem to rest on a logical basis. Occasionally we find references to peculiarities of spectra but nowhere do we find a clear description of the laws of spectrum analysis, the spectra of stars and their classification. It is hoped that in a later edition the author will take the opportunity to revise these two chapters and place them on a level with the other parts of the book.

Space does not permit a detailed discussion of the several topics which might have been included. There are some typographical errors and occasionally a loose statement is met with. As an example we may quote the passage in page 322 "Thus Sirius was known only to be a spectroscopic binary until....". It is a well-known fact that the existence of the companion was predicted from the periodic variations in the proper motion of Sirius first by the researches of Bessel and later on of Auwers, long before A. G. Clark discovered the star by visual observation.

The diagrams illustrating the text appear to be carefully drawn, but the photographic reproductions leave much to be desired. A few typical photographs selected from the collections of the great American Observatories will add much to the value of this part of the book.

The chapter on "Thirty Constellations" forms interesting reading and cannot fail to

be of assistance to the beginner in astronomy in studying his sky. In the next chapter, (Chapter XX) we find a good description of the principal astronomical instruments, their uses and also a discussion of the chief sources of error they are subject to and the usual methods of adjustment. There is a collection of examples at the end of the book and a set of appendices and tables useful to the student of practical astronomy. If one may venture a suggestion, a few worked examples in the body of the chapter would be helpful to the reader in understanding the text.

The volume is to be commended on the whole, as a laudable attempt by the author to combine the general features of a standard text-book on spherical astronomy with a brief resume of the principal facts of descriptive astronomy. T. P. B.

The Diseases and Pests of the Rubber Tree. By A. Sharples. (Macmillan and Co., London.) 1936. Pp. xvii + 480. 25*s*. net.

This is quite distinct from Petch's book of the same name also published (in 1921) by Messrs. Macmillan, and advertised on the wrapper of the present volume as still being on sale.

The manual now published represents a welcome and up-to-date account by an acknowledged expert, who since 1913 has specialised in the pathology of *Hevea brasiliensis* under Malayan conditions.

Of the 480 pages comprising the book, Part I (45 pp.) is devoted to general remarks on plant diseases, with special reference to those of the rubber tree. This part is well written and is justified in a book intended largely for use by planters. The discussion on pp. 10 and 11 as to when a mycologist ceases to be a mycologist and becomes a plant pathologist is largely a matter of words, the facts already being fairly obvious.

Part II (19 pp.) gives a sketch of certain aspects of plant anatomy and physiology, and in the reviewer's opinion, might well have been omitted, as it seems somewhat out of place and is too elementary and condensed to be of any great value.

Part III, the remainder of the book, is devoted to diseases and pests.

Root diseases (pp. 75–207) are very fully treated. Recent work on the morphology of *Sphærostilbe repens* is described. Views of the *Fomes* types of root-fungi have changed considerably of late years; spread through the soil occurs through root contact, and the essential control measure is complete removal of infected jungle timber.

Tapping panel diseases occupy pp. 208–65, and include full descriptions of Mouldy Rot (*Ceratostomella fimbriata*), and Brown Bast disease (physiological). On p. 243 the identity of the Black Stripe organism *Phytophthora faberi* Maubl. with *P. palmivora* Butl. is admitted; *P. meadii* McR. and *P. heveæ* Thompson are here given as separate species, though recent investigators agree in regarding them as also synonymous with *P. palmivora*. On pp. 313–14 the old name *P. faberi* is again used.

Among stem diseases, the most important in Malaya are Pink Disease, stem *Ustulina*, and *Diplodia* Die-Back. Leaf Fall due to *Oidium heveæ* is best controlled by sulphur dusting. Miscellaneous matters such as lightning damage, sun-scorching, abnormalities, and spotting of prepared rubber are fully dealt with.

Insect diseases (pp. 369–413) appear to be dealt with comprehensively, special attention being devoted to white-ants and cockchafer grub.

Remaining chapters deal with Animal Pests, Forestry Methods of Cultivation and Treatment of Disease. A well-justified warning is given on p. 430 against the touching faith of manufacturers in the Rideal-Walker standardisation as applied to fungicides.

An Appendix gives a useful list of all the fungi, parasitic or saprophytic, that have been recorded on rubber trees in Malaya.

The book is well illustrated, the microphotography being particularly good and misprints and slips are rare. One misprint which may be mentioned, since it appears in almost every mycological paper published in India, (although noticed only once in the present book), is "casual fungus" on p. 295 for "causal fungus"; another still more universal error is the misuse of the word "fungoid", *e.g.*, on p. 9. A fungoid growth is not a fungal growth, but a growth that merely *resembles* a fungus—the "cauliflower ear" of a pugilist, for example, may correctly be termed fungoid, but a specimen of *Hirneola auricula-judæ* may not.

L. D. GALLOWAY.

Theory of Lubrication. By M. D. Hersey. (Chapman & Hall, London; John Wiley & Son, New York.) 1936. Pp. x+152. Price 12*s*. 6*d*.

Lubrication is essentially a practical problem. However a theoretical understanding of

the problem and its applications have a great effect on the design and operation of machinery, reduction of space occupied and the power utilised as also the lengthening of the life of the bearing surfaces to a great extent.

"Lubrication like every other mechanical action is governed by Newton's Laws of Motion upon which the science of mechanics is based. Sir Issac Newton (1687) discovered the fundamental laws of viscous resistance underlying the theory of lubrication according to which shearing stress is proportional to the rate of shear." On the basis of this concept the author shows the difference between liquids, non-Newtonian liquids and plastics. Petroff's equation and the Poiseulle's law have been derived as examples of applications of Newton's law. "It appears that for any given bearing, the frictional torque is proportional to the viscosity of the lubricant and the speed. For bearings of the same diameter with different shape factors, the torque is directly proportional to the length and inversely as clearance. For bearings of different sizes but geometrically similar, the torque is proportional to the cube of the absolute size."

"When a film is not of a uniform thickness there will be a positive fluid pressure developed in the converging portion of the film, as pointed out by Reynolds. This pressure supports the load, floats the journal or other moving surface and under favourable conditions entirely prevents metallic contact." Chapter III deals with the mechanical phenomena in the film, leading to the derivation of Reynolds' equation for the pressure distribution in the film (under steady running conditions with an incompressible lubricant) based on the general equation of the hydrodynamic theory. Full integration of the Reynolds' equation by Sommerfeld, Michell Stodola and others including the electrical integration by Kingsbury are given at length.

"The most evident limitations of the hydrodynamic theory in its present state of development and application may be considered under three heads: (1) The point of view of analysis; (2) Physical limitations; and (3) Geometrical limitations."

"1. Some of the most ingeneous and successful investigations such as Kingsbury's ..... have been conducted strictly from the view-point of bearing design. The results therefore are not directly applicable in calculating the probable performance of a bearing of any fixed design, or in selecting the most suitable lubricant for existing machinery."

"2. The treatment is usually limited to a steady state with constant viscosity and in most investigations, even when side leakage is taken into the picture, the effects of negative pressure are dealt with in some arbitrary and artificial way."

"3. The bearing surfaces are assumed perfectly smooth and rigid and of some ideally simplified geometrical form; the applied loads other than the driving torque, reducing to a single resultant force, conveniently located for purposes of calculation."

Because of these limitations under experimental conditions "the number of observations necessary for exploring the field in connection with any one type of machine element may be very considerable and the expense correspondingly great, when separate factors are varied over full range one at a time."

These difficulties are sought to be overcome by the combined mathematical and the experimental approach of the dimensional theory outlined in Chapter IV. This theory has been developed from elementary principles and it is shown that the results of this theory in comparison with those of the classical hydrodynamic theory bears no inconsistency. "The dimensional theory provides a partial mathematical solution for problems that are too complicated to be dealt with by the more usual methods of integrating of differential equations."

After considering the problems arising out of temperature rise in the bearings the author takes up the problem of oiliness in Chapter VI. "A condition known as imperfect lubrication will be introduced when the load is too great, the speed or viscosity is too low, the rubbing surfaces held parallel or the quantity of lubricant insufficient. This condition can be almost avoided under modern methods of designing and operating bearings, though it is difficult or impossible to escape in the operation of heavy duty gears and cutting tools. Even in case of journal bearings which appear to be correctly designed (so far as can be judged from the blue print) excessive loading may be caused locally on small areas due to misalignment, roughness, or elastic and thermal deformation. The well-known phenomena associated with oiliness, wear, and seizure then take place." Various definitions of oiliness which are vague in themselves are given. Oiliness may be considered as a

property of the oil or the joint property of metals and oils. Herschel uses the word oiliness and defines it " as the property that causes a difference in the friction when two lubricants of the same viscosity at the temperature of the film are used under identical conditions." This admits of no difference between oiliness and viscosity. However no one definition seems to be wholly satisfactory. " Regrettable confusion tending to retard technical progress might be caused by the indiscriminate use of the term *oiliness* for any and all meritorious characteristics of a lubricant." In conclusion various hypotheses (like those of plasticity, bulk effects, intensive viscosity, adsorption, adhesion and stratification) for oiliness are mentioned.

The author has kept close to his theme of a theory of lubrication and has scrupulously avoided experimental side and such other explanations which might form a digression. A condensed treatment has been achieved at the expense of possibly more interesting details. The mathematical details have been clearly worked out; and after a certain stage the author does not fight shy of taking aid of qualitative reasoning for drawing relevant conclusions.

However certain very elementary things like the conversion tables in pages 31, 102 and the dimension tables like those in pages 76 and 95 might have been conveniently transferred to an appendix at the end of the book.

While dealing with oiliness one expects a more detailed treatment of the recent works of Hardy, Langmuir and others on film and boundary lubrication, than a mere passing reference.

Every chapter contains a list of complete and up-to-date references of its own and the text is fully punctuated with reference numbers. The author in his introduction refers to the book as a key that might open the box containing a bunch of keys (references). Unless the " keys " are presented in a more attractive fashion and their relative values exposed, though at the cost of condensed treatment, there may not be enough inducement to make use of them.

The book is nicely printed and got up well.

B. S. SRIKANTAN.

Morphology of Vascular Plants: Lower Groups (Psilophylales to Filicales). By Eames, Arthur J. McGraw-Hill Publications in Agricultural and Botanical Sciences. (McGraw-Hill Book Co., Inc., New York and London.) 1936. Pp. xviii + 433. 24*s*.

Morphological literature on the vascular plants has been accumulating so rapidly during the last few years that both teachers and students have keenly felt the need of a suitable book in English to supply this information in the form of a connected narrative. The reputation of the author as a lucid and interesting writer is well borne out by his previous book on "Plant Anatomy" written in collaboration with Dr. L. H. MacDaniells. That this work, like the last one, should be quite in touch with the present state of our knowledge on Pteridophytes, was of course expected of its author and this expectation has been fully justified.

The view-point is that of " broad comparative study, with the development of a natural classification and phylogenetic relationships as the goal." Emphasis has been placed on the range of structure within a group rather than on cytological and anatomical details about individual forms. The treatment embodies the whole of the Pteridophytes or "Lower Vascular Plants," as the author prefers to call them.

The first chapter deals with the Lycopodiaceæ, although it may perhaps have been more logical to start with the Psilotaceæ which are now regarded as the simplest living Pteridophytes. The second deals with *Selaginella* and calls attention to several important features not described in other text-books. With regard to the morphology of the rhizophore, the author states that they "appear to be modified stems", a view which can hardly be justifiable on anatomical grounds. The reviewer is inclined to consider them in the nature of aerial roots, which bear other roots immediately on touching the ground, as in some spp. of *Ficus* and *Tinospora* (see also Uphof, *Ann. Bot.*, 1920). The Bibliography on this genus calls attention to several important papers that have appeared recently. To these may well have been added the work of Wardlaw on its anatomy and Geiger on the development of the megagametophyte, fertilisation and appomixis.

Chapter III gives an excellent account of the problematic genus *Isoetes* and IV deals with the Psilotales. Ford's secondary xylem elements at the base of the stem have been considered (and perhaps quite correctly) as centrifugally developed cells, so that the xylem is mesarch in this region.

The next chapter deals with the Equisetales

and is concluded with a brief but illuminating comparison of the forms dealt with so far. Rumberg's excellent work on the prothallia of *Equisetum* (*Planta*, 1932) has perhaps escaped the notice of the author.

Chapters VI to XIII deal with the Filicales. Teachers will always turn to Bower's classical work on this order for detailed information but from the student's point of view we have here an admirable and logically organised mass of facts on the group. The next three chapters describe the Fossil Pteridophytes and the last gives an account of alternation of generations and classification of vascular plants. The volume is concluded with a useful Index of 21 pages.

There is a total of 218 figures, admirably executed when original, and well selected where they have been borrowed. Those engaged in teaching this group will probably lament the passing away of some old friends, but in general the author is to be congratulated on his choice.

It is difficult, where all is so good, to point out the best. We are so charmed by Prof. Eames' account of the life-histories that we are less ready to forgive him for the abbreviation of many anatomical details, especially on *Selaginella* and Filicales.

P. MAHESHWARI.

Die Verbreitung der hoheren Wasser pflanzen in Nordeuropa (Fennoskandien und Danemark). By Gumnar Sammelsson. (Acta Phytogeographica Saccica VI., pp. 1—211 : 50 figs.) Upsala, 1934.

In this monograph the author has discussed the results of his studies on the distribution of the higher plants of Northern Europe (Finland, Scandinavia and Denmark) which he commenced in 1919 and has continued since then.

The author has recorded on maps, accompanied by lists of localities, the distribution of all the aquatic species present within the area. Forty-seven of these have been included in the monograph and the author's conclusions are mainly based on them.

The total number of species investigated is 149, of which 6 are typically salt-water and 19 are brackish and fresh-water species ; of the 135 fresh-water types, 110 are submerged and the rest are amphibious.

The author's conclusions are contained in the last three chapters, which deal with the effects of climate (Ch. IV), soil and water types (Ch. V) on the distribution of aquatic plants, together with the history of immigration of the types into the area (Ch. VI).

The author ascribes the present-day distribution of species mainly to the long-continued operation of ecological factors (climatic as well as edaphic) and is very critical of the tendency to ascribe it to the working of hypothetical factors such as previous wide distribution of the species, their relict nature, and their wanderings before making a careful analysis of the working of the ecological factors at work to-day. The author attaches great importance to the nature of the locality in determining the distribution of various species. Depth of water, the structure of the soil, the movements of water (currents, etc.) and its chemical composition are all recognised as having great influence on the occurrence of particular species. In addition, the Biotic factors such as the competition of the various species among themselves, the capacity of particular species to produce favourable conditions for the growth of others (*e.g.*, those which only grow in quiet areas or in clear areas between thickets of another), the influence of lower organisms on the composition of the water (particularly its oxygen content and temperature) are all considered from this point of view.

For a discussion of the history of immigration of the species the author utilises the results derived from a study of the fossil flora of the quaternary strata.

He comes to the conclusion that at least the most common aquatic species of South Sweden have migrated into it from the South soon after the melting of the land ice before the end of the Ancylus period.

The history of the Norwegian flora is not so well known, but it is assumed that it dates from the boreal period. As regards Finland the author is of opinion that in South and Central Finland an aquatic flora existed similar to the flora of South Sweden of the same period. The author considers that changes of climate which are known to have taken place in post-arctic times must have influenced the distribution of aquatic types very considerably. The steadily contracting northern limit of Trapa and other genera prove this. A steady cooling of the climate set in during the transitional period from the Bronze to the Iron Age. The climate became not only colder but also markedly oceanic. This led to progressive changes in the habitat which favoured

particular species at the expense of others. The present-day distribution may, therefore, be regarded as resulting from the interaction of the sum total of the environmental factors on the plants themselves.

The monograph itself must be consulted for details. S. P. A.

Cinématique des milieux contimus. By Ch. Platrier. (Actualités Scientifiques ee Industrielles, No. 327.) (Hermann et Cie, Paris.) 1936. Pp. 34. Price 8 *fr.*

This volume is the third of a series of three books written by the author on the science of kinematics. This is a small book of thirty-four pages and of three chapters, dealing with the kinematics of continuous media. The first chapter gives an account of the continuous transformation, deformation tensor and its main properties, while the second chapter is devoted to infinitely small deformations and the third one deals with the methods of Lagrange and of Euler in the kinematics of deformable bodies. The book covers the major part of the subject-matter treated in the chapters 32 and 33 'Traite de Mecanique Rationnelle', tome troisieme by P. Appell. The subjects are treated with remarkable conciseness and lucidity and the author has succeeded in conveying much information in a small space.

M. N. N.

Phenomnèes photoèlectriques et leurs Applications. Par G. A. Boutry. I. Phenomènes photoémissifs, Pp. 100. Price 20 *fr.* II. Cellules photoémissives, Pp. 59. Price 15 *fr.* III. Photoconductivité, Pp. 84. Price 20 *fr.* IV. Différences de Potentiel photoèlectriques, Pp. 51. Price 15 *fr.* V. Photomêtrie photoélectrique (Mesure des Courants), Pp. 51. Price 15 *fr.* VI. Photomêtrie photoélectrique (Mesure des Flux), Pp. 72. Price 15 *fr.* (Nos. 312, 313, 336, 337, 345 and 346 of Actualités Scientifiques et Industrielles. Hermann et Cie, Paris.) 1936.

It is remarkable that two discoveries like that of the electromagnetic waves and of the photoelectric effect which led physicists to exactly opposite conclusion regarding the nature of light should be associated with the name of one physicist, *viz.*, Heinrich Hertz. It is equally remarkable that both should have developed into extensive branches of applied physics associated with mighty industries like radio, talkies and television. The simplicity and beauty of Einstein's explanation of the photoelectric effect is all that we see in the ordinary text-books. But what variability and complications are associated with the phenomenon can only be appreciated when we delve into the details. The books before us give a finely balanced and impartially critical resumé of the facts in this maze of secondary effects. The presentation is elegant and inviting. The limitations of the results so far achieved are indicated and suggestions for further investigation are judiciously thrown out. The bibliograpy at the end of each chapter contains critical remarks on each paper and is a very valuable guide. The emphasis is on the experimental side but the relevant theory is introduced wherever necessary. Apart from a description of the various types of photoelectric cells, methods of measuring the currents, methods of amplification necessary for most purposes, photoelectric relays and so on, there is no account of technical or industrial applications as such. On the other hand the various properties of cells and the different methods of measurement common to all applications are the objects of description.

Within these limits, however, the account is detailed and full. The titles of the several volumes give a correct idea of the contents so that we need not elaborate this side of our remarks. In some places the description is rather short and not quite clear. Thus in I, pp. 21 and 22, in the description of Fig. 13 the letters A and S are mentioned but are not to be found in the figure. So also in III, pp. 9 and 10, the regions (1) and (2) referred to in the text are not marked in the corresponding diagram. There are also a few misprints here and there. The books on the whole, however, can be unrestrainedly recommended to all who require a just view of an important subject full of intricacies in the details.

Théorie de Diffuseur (Haut-Parleur sans Pavillon). Par F. Bedeau (No. 281 of Actualités Scientifiques et Industrielles.) (Hermann et Cie, Paris.) 1935. Pp. 67. Price 15 *fr.*

This is a clear and readable account of the construction and working of the moving coil loudspeaker of the type designed by Rice and Kellogg. The theory behind the details of the design is dealt with in detail. The explanation of the theory as *e.g.*, the idea of acoustic impedance is illuminating. The numerical example on pp. 50–53 brings the theory home in a concrete fashion. There are a number of obvious misprints, *e.g.*, on pp. 18, 23, 25, 30, 34, 36, 46, 50, 60

and 64. On p. 7 it is not stated how the line CK in Fig. 3 is to be drawn. Apart from these minor defects, the book provides a good account of the design and testing of a moving coil loudspeaker and may be recommended.

Le deuxième Theorème de la Thermodynamique et la Mécanique ondulatoire. Par Satosi Watanabe. (No. 308 of Actualités Scientifiques et Industrielles.) (Hermann et Cie, Paris.) 1935. Pp. 93. Price 20 *fr.*

The book represents an attempt to provide for the second law of Thermodynamics a rigorous and logical foundation based on wave mechanics. The method of Carathéodory has been modified to suit the new mechanics. Classical conceptions such as extension in phase space have been eschewed and a systematically quantum mechanical viewpoint is maintained. However, the author has had to resort to what he calls "the thermodynamic criterion," *viz.*, the proposition that "A thermodynamic state cannot be divided into more than one thermodynamic state by an adiabatic transformation." The subject is difficult, and, as L. de Broglie says in his preface, "the book must be read carefully." When this is done the reader will encounter very keen reasoning which almost leads to conviction; the rest must be left to the judgment of much more competent critics.

Reaction Topochimiques. Part I.—Generalites; Part II.—Le Nitration de la cellulose; Part III.—Le Gelatinisation des Nitrocelluloses. By Marcel Mathieu. (Actualités Scientifiques et Industrielles. Nos. 315, 316 and 317.) (Hermann et Cie, Paris.) 1936. Price 12 *fr.* each.

The compounds formed by the polymerisation of simple molecular groups, such as the paraffins, the polysaccharides, etc., present characteristics which are often difficult to interpret with the usual chemical or physico-chemical laws. Apart from the reactions in which the molecular structure is broken down as in the hydrolysis and splitting of molecules, an important characteristic of these complexes is the several reactions to which they can be submitted while conserving in general their crystalline structure. Such reactions go under the general name of 'topo-chemical' reactions. A typical example is the nitration of cellulose, where the NO_2 groups replace the reactive OH groups in the cellulose molecules continuously with very little change in the lattice-structure. These topochemical reactions which take place in the molecular edifice itself, have the characteristic of a solid solution. They play an important rôle in the phenomena of assimilation by living organisms and in the changes taking place in living tissues.

M. Mathieu has presented in these three monographs a very interesting and readable account of the studies on cellulose, and of the classical works of Astbury, Meyer and Mark, Bragg, and others. The monographs can be warmly recommended for all those interested in the structure and reaction of highly polymerised compounds such as the polysaccharides, the polyprenes, the proteids and the bakelites. M. A. G.

The Problem of Nutrition. Published by the League of Nations. Vol. I, Interim Report of the Mixed Committee; Vol. II, Report on the Physiological Bases of Nutrition; Vol. III, Nutrition in Various Countries; and Vol. IV, Statistics of Food Production, Consumption and Prices.

These four Reports are the result of the action of the 1935 League Assembly, which set up a "Mixed Committee," including agricultural, economic and health experts, to prepare a report on nutrition, and instructed the technical organisations of the League to "collect, summarise and publish information on the measures taken in all countries for securing improved nutrition." Vol. I is a general report which may profitably be read in conjunction with the International Labour Office Report *Workers' Nutrition and Social Policy.** It is a preliminary report, and its conclusions and recommendations are tentative. The need for educating the medical profession, its auxiliaries and the general public, in the newer knowledge of nutrition is strongly emphasised. Of other recommendations, the following are of particular interest:—

"Governments should consider what steps should be taken, whether at the public charge or otherwise, to meet the nutritional needs of the lower-income sections of the community, and, in particular, the means by which they might ensure that an adequate supply of food, especially safe milk, should be made available for expectant and nursing mothers, infants, children and adolescents.

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* "Studies and Reports Series B (Social and Economic Conditions)," Geneva, 1931, No. 23.

"Governments should consider whether any modification of the general economic and commercial policy is desirable in order to ensure adequate supplies of foodstuffs, and in particular, to assist the reorientation of agricultural production necessary to satisfy the requirements of sound nutrition."

One recommendation is of interest to those concerned with nutritional problems in India: The Mixed Committee "invited the assembly to recommend the governments concerned to give their full support to the Health Organisation in its enquiries into the widespread malnutrition which exists in the tropics and certain Far Eastern countries."

The present report, drawn up by a committee including experts of varying nationality and outlook, is in places somewhat ponderous and platitudinous. Nevertheless it does adequately define the problem of nutrition in relation to public health and state activity in general, and indicates the lines which must be followed if the discoveries of modern nutritional science are to benefit mankind in general.

Vol. II contains a revised version of a Report† issued in December 1935, in which optimum dietary requirements were defined in terms of foods and food factors. It sets up the objective to be striven for by conjoint effort. In addition to the diet schedules for pregnant and nursing women, infants and very young children given in the first report, schedules for children 5–7 and 12–14 years of age are included. There is a good definition of what is meant by "protective" foods, and a more detailed account of calorie and protein requirements. Doubtless this report will meet with some technical criticism on the part of nutrition workers and will need modification from time to time, but in general its recommendations are sound as far as present knowledge goes, and it will adequately fulfil the purpose for which it was drawn up.

In Volume III one finds a mass of valuable and hitherto quite unavailable information about public health nutrition work in some 27 countries. The chief activities dealt with are the following:—

Measures taken on behalf of mothers and infants.

Measures taken on behalf of children of school-age and young people.

Measures taken on behalf of adults, and in particular of unemployed adults.

Army and Navy dietaries.

Measures to enable particular categories of consumers to obtain foodstuffs at reduced prices.

Measures for ensuring the quality of foodstuffs.

Research, education and popular instruction with regard to food values.

It is surprising to note how much is being done throughout the world under these various heads. One must, it is true, remember that the data in the report were supplied by government departments in each country, and there is a natural tendency to make the best display possible. But in general it appears that governments are becoming aware of their responsibilities in connection with the feeding of populations. The Report, 271 pages in length, will be a useful reference work for those concerned with practical aspects of nutrition. The fact that advances are being made in this field elsewhere in the world, even in very poor countries with large peasant populations, should stimulate the study and attack of the problem of nutrition in India.

Vol. IV, "Statistics of Food Production, Consumption and Prices," has been prepared by the International Institute of Agriculture, Rome. The first 36 pages provide a general summary of production and consumption trends, and the remainder of the Report is devoted to appendices containing Tables of Production and Consumption, Price Index-numbers, etc. The International Institute of Agriculture was asked by the Mixed Committee to pay particular attention to what are sometimes known as the "protective" foods, but the first sentence in the Report indicates the difficulty of complying with this request. "Statistics of production, in any country, of the protective foodstuffs—milk and its derivatives, meat and fish, eggs, fruits and fresh vegetable—are notoriously unsatisfactory. Relatively few countries ever attempt to compile annual estimates of complete national production: hardly any of those that do make the attempt would care to claim more than a very moderate degree of accuracy in the figures they compile." Nevertheless, in spite of the defects in the available data, it has been found possible to reach some general conclusions in the case of 16 European countries, the United States, Canada, Australia and New Zealand.

† C. H. 1197, Geneva, 1935.

Production of milk is, in general, increasing in these countries. Butter shows the same upward trend, which has, however, been slightly checked in the last year or so. In some countries which are largely exporters of butter and cheese production has diminished, a compensatory rise being visible in countries which are normally large importers of these foods, and which are now seeking to develop home production. Meat production is, in general, rising, but here again a check is visible in the great meat-producing countries—*e.g.*, Australia. The trend of the production of eggs, fruit and vegetables is also upwards. Consumption in most cases runs parallel with production and it thus appears that the quality of national diets in Western civilisation is improving.

An interesting section is that dealing with "Measures of Financial Assistance to Agriculture." Methods followed in the United States under the Agricultural Adjustment Act (A. A. A.) have been particularly striking. The government adopted the policy of buying live-stock from the farmers to relieve congestion and to raise prices, but this was not simply destroyed and lost to the nation; the "surplus" food so obtained was largely handed over to unemployment relief organisations, or made available for improving the nutrition of school children, etc. The commodities purchased and handed over to unemployment relief agencies included dairy products and sugar. The government spent 204 million dollars in this way in two years, but of this 187 million dollars were recoverable advances to government relief organisations. The A. A. A. has now been pronounced "unconstitutional" by the Supreme Court, a remarkable example of how the development of government on modern scientific lines may be checked by an outworn eighteenth-century constitution.

All these reports will repay careful study on the part of scientific, medical and public health workers in this country. W. R. A.

Indian Science Abstracts. (Being an annotated bibliography of Science in India.) Published by the National Institute of Sciences of India, 1936. Price Rs. 7–8–0.

The number of active centres of research scattered in different parts of India and their scientific output have been increasing at a rapid rate during the past decade or two. The need has been increasingly felt for a collection of the scattered scientific literature of the country, which would help in avoiding duplication of work at different centres and also offer the results obtained at one centre early enough to workers elsewhere, interested in similar or allied problems, to be of advantage to them. The increase of literature, especially in the biological sciences, was felt to such an extent that the Society of Biological Chemists (India), soon after its inauguration, undertook the publication of an Annual Review of *Biochemical and Allied Research in India*, the first number of which appeared in 1931.

The attempt on the part of the National Institute of Sciences of India to publish an annotated bibliography of scientific literature in India under the caption of *Indian Science Abstracts* should therefore be welcomed as opportune. Such a publication, however, if it is not intended merely to serve as a record of Indian achievements in Science but prove of any help to the research workers in India, should aim at certain requirements such as completeness, quality and earliness of publication.

Considering the comprehensiveness of the sciences taken up for abstracting, which range from Astronomy and Anthropology to Metallurgy, Palæontology and Zoology, it would have been fortunate if the editors could have secured the co-operation of existing scientific societies in India specialising in particular fields to undertake the editing of the parts relating to their respective spheres. In fact, instead of having the abstracts belonging to widely differing subjects all under one cover and charging a high rate for the whole, it would have been better if the parts had been issued separately. It is rather surprising that the editors have not thought fit to number the pages, as such numbering would have facilitated references to the abstracts.

The volume purports to be Part I for the year 1935, but it is not stated whether the subsequent parts would cover the same ground or other subjects not included in the present part; if the former, one may ask why the publication could not have been delayed till the fresh matter could also be incorporated, as it would have simplified alphabetical classification and subsequent reference to the contents; and, if the latter, the volume is incomplete and does not do justice to the great volume of literature that has been issued in India on the subjects covered. Continuity of quality and comprehensiveness of matter abstracted could best be secured through an efficient agency of workers organised on a business footing and preferably acting under the guidance of specialist scientific societies. C. N. A.

Correlation of the Ancient Schistose Formation of Peninsular India.*

IN Part I of this memoir, reviewed in the September number of this Journal, Sir Lewis Fermor divided the Archæan rocks of India into regions and provinces for purposes of description. No. 1 of Part 2, which is the subject of the present review, describes three of these provinces the Dharwar-Mysore-Nellore Province, the Chanda-Bastar Province and the Singhbhum-Orissa Province.

THE DHARWAR-MYSORE-NELLORE PROVINCE.

This is the first province to be described as it contains the so-called "classic ground in which Foote originally separated the Dharwar formation from the associated gneisses." In other words its priority arises entirely from historical considerations. Sir Lewis treats us to a fine summary of the work which has been written on the non-charnockite areas of South India, and lucidly traces the oscillations in view-point and understanding of successive geologists who have worked on these rocks.

Newbold's earliest views, expressed in 1844, that the granitic rocks had intruded into earlier schists and gneisses, was largely accurate and it is curious that over 60 years elapsed before this view became accepted. It is a fine illustration of how scientific advancement is so often held up by blind belief in a popular view.

R. B. Foote's first descriptive work on the South Indian rocks appeared in 1876, but it was not until 1886 that he proposed the term "Dharwar" for the schistose rocks which occur as wide bands in the "granitoid gneisses," and later described eight such bands. He refers to the Dharwar system as "Lower Transition," and, rejecting Newbold's views of the intrusive relation of the gneisses into the schists, concluded that the Dharwar rocks rested unconformably on the granite-gneisses.

J. Malcolm Maclaren, who worked in this part of India for a very short time at the beginning of this century, continued to believe in this stratigraphic unconformity between the Dharwars and granite-gneiss. Maclaren did no detailed mapping yet he drew comparisons between these Dharwars and the rocks in Chota Nagpur, Rajputana and even Bihar and Shillong. Maclaren's work in the economic field was invaluable, and he was one of my earliest friends in geology, but I am of the opinion that this correlation was the one unfortunate contribution which Maclaren made to Indian geology. The term Dharwar should not have been given such a wide significance in Indian geology at that stage, as the comparisons were not based on mapping but on mere generalised lithological resemblances. Its use has given a bias or colour to all subsequent work in these areas, which should never have been present.

Then followed the work of the Mysore Geological Department of which Foote himself was the founder. No comprehensive account of this part of India has appeared since Smeeth's outline in 1916. The Dharwars are divided into an upper (chloritic) and a lower (hornblendic) division without any break between the two, and the whole intruded by a succession of granites and basic igneous rocks, the Dharwars being recognised as the oldest rocks present. Smeeth, in 1926, concluded that the "lower division" is intrusive into the "upper," a view which Jayaram later rejected. A calcareous and manganiferous division has also been recently recognised, and known as the "Sakarsanhalli series" which may be a still lower division. Of the intrusive granites the Peninsular gneiss is the most widespread.

The various opinions as to whether the quartzites, ferruginous quartzites, limestones and schists are of sedimentary origin or are due to replacement of igneous rocks, are stated fairly enough by Sir Lewis, as also is the controversy concerning the sedimentary or crush origin of certain conglomerates. Notwithstanding that Sir Lewis refuses "to accept any conglomerate in the Archæan as truly sedimentary except on the most rigid proof," an attitude which he so strongly assumes in Part I, it is good to read that he does acknowledge the recent views of Rama Rao and Pichamuthu that sedimentary conglomerates actually occur. His criticism of Iyengar's, Smeeth's and Jayaram's inclusion of the intrusive Champion gneiss as part of the Dharwar system is justifiable.

Rama Rao and Jayaram were the first of recent writers to reject the view of Smeeth and Iyengar that all the Dharwars are of igneous origin, and they accept a sedimentary origin for many of these rocks,

*"An attempt at the correlation of the ancient schistose formation of Peninsular India," by L. L. Fermor, *Memoirs of the Geological Survey of India*, 1936, **70**, Part 2, No. 1, pp. 53-217.

Sir Lewis' review of this work in South India leaves an impression that needless, weak and illogical arguments were the burden of past descriptions, and that a little acknowledgment of simple views and analogies from other areas would have cleared the air. It is all expressed so concisely by one small phrase in the memoir: "After all, the Sakarsanhalli rocks are mainly shreds"—the same might be said of all these schist belts of South India as compared with the Archæan tracts in other parts of the country. This, indeed, is one of the reasons why I believe that the Dharwars have been given a position as a type system in our Indian stratigraphy out of all proportion to their importance. Those who have worked long in India will read this historical account with a certain feeling of regret, perhaps, that Sir Lewis has found it necessary to take out some of our skeletons once more for an airing.

CHANDA-BASTAR PROVINCE.

This extends north from the Godavari River and three-quarters lies in the Central Provinces. It is bounded on the east roughly by the Eastern Ghats and on the west by the Deccan Traps, Gondwanas and Puranas. Little has been published concerning this tract during recent years, and the last memoir of any importance appeared in 1902. Sir Lewis refers to Smith's account of the Raipur and Sambalpur Districts, dated 1899, as "fairly modern"! Amongst other faultings Sir Lewis deduces evidence for a fault zone some 600 miles in length, which threw down the Chandar-Bastar Province several thousand feet relative to the adjacent Eastern Ghats Province.

During the last few years Geological Survey of India parties have been engaged in the Bhandara District of this province under the supervision, until recently, of Sir Lewis. Here, the Sakoli series is regarded as younger than the Sausar series which crops out to the north. A survey of Bastar State in the eastern part of this province, has recently been commenced by Mr. H. Crookshank and Dr. P. K. Ghosh. There, a series of metamorphosed sediments have been intruded by granitic rocks; ferruginous quartzites form an important part of the series. Summarising the features of the Chanda-Bastar Province Sir Lewis notes that the phyllites, schistose rocks and gneisses are more or less parallel to the general north-south trend of the rocks in the Dharwar-Mysore-Nellore Province. The phyllite-schist suite has received different names in different areas: Sakoli series in Bhandara, Chilpi Ghat series in Balaghat and Drug, and Sonakhan series in Bilaspur, Raipur and Sambalpur. All are compared with the Dharwars of South India. The chief rocks are slates, phyllites, mica schists, chloritic and hornblendic schists, quartzites and hematite-quartz-schists. Calcareous rocks are entirely absent.

The province is very large, the schists are widely separated in the granite-gneiss. So little is known, apart from the Sakoli and Sausar series, that there is no justification for any correlation as yet between each area.

THE SINGHBHUM-ORISSA PROVINCE.

We come next to the area which has been my own hunting ground during the last fifteen years. It is a small province, but it will be interesting to see later the reason for the separation of the Ranchi and Bihar Provinces which lie to the north, and which in actual fact form a very definite unit with Singhbhum geology. Economically it is the most important of all the provinces.

Sir Lewis summarises the early work of Haughton, Stoehr, Ball, Maclaren and Fermor in Singhbhum and surrounding areas; of these Ball alone did any extensive mapping, but Fermor mapped about 20 square miles around some chromite deposits. The early views were more or less parallel to those expressed for South India, except that at no time was such a wholesale relation of schists to an igneous origin postulated. Ball's memoir (1881), the result of reconnaissance work of a most erudite type, was the most momentous, but to a modern reader it suffers from inhibitions attendant on the geological beliefs of those days—the same will certainly be said of our own work, perhaps, in the future!

An important omission is the work of K. A. K. Hallowes in 1905–08, whose progress reports were available to Sir Lewis. He was the first to point out the intrusive nature of the granites into the schists, and there is much valuable information buried in Hallowes' reports.

A good account is given of the more modern detailed surveys which have covered approximately 10,000 square miles since 1920. The three principal workers, Jones, Dunn and Krishnan, receive a good hearing, with also a mention of Dey's work; I should have liked to have seen some reference to the work of other colleagues, for example to Hobson and Iyer who have done some useful mapping in this area. This work has been recently described in several memoirs and others

will appear shortly. But even so, I feel that our conclusions are unsatisfactory. Almost at the beginning Jones found that wonderful section along the Deo river where the basal bed of the Iron-ore series rests on the vertical beds of an older metamorphic system—in no country have I seen exposed so clear a section of the unconformity between two Archæan systems. Almost from the beginning, therefore, we were aware that two systems of rocks were present: indeed my own field-work in India commenced from the actual site of this Deo river section. In Singhbhum and surrounding areas we have the following succession :—

Iron-ore series	(7) Dalma lavas, with agglomerates and phyllites.
	(6) Dhanjori quartzites (with occasional conglomerates) impersistent.
	(5) Phyllites with tuffs, lavas, limestones, conglomerates, quartzites.
	(4) Banded-hematite-quartzite.
	(3) Shales, phyllites, mica-schists.
	(2) Limestones—impersistent.
	(1) Basal sandstone–conglomerate.

Older Metamorphic System.

The Older Metamorphic system does not cover a wide area, but wherever found its rocks are in every respect lithologically similar to the metamorphosed types of the younger Iron-ore series. Although no banded hematite-quartzites and iron-ores have as yet been found in the older group, the fact that pebbles of these ferruginous rocks occur in the basal conglomerate of the Iron-ore series indicates that such iron-ore rocks were present in the Older Metamorphic system. Lithologically the older system resembles the Dharwars of South India just as much as does the Iron-ore series.

The Iron-ore series should be regarded as a *system*, but it is the policy of the Geological Survey to retain the term *series* until correlations between widely separated areas have been effected. The unconformity between the Older Metamorphic system and the Iron ore series represents a vast period of time, but in the Iron-ore series itself there are overlaps and erosion intervals permitting a grouping of the beds into stages. Going downwards in the system there was an erosion interval immediately preceding the Dalma lavas, a very considerable erosion interval preceded the Dhanjori quartzite and conglomerate, brief intervals occurred in the underlying stage of tuffs, etc., and finally, in South Singhbhum and Keonjhar, such a prolonged period of erosion preceded the banded hematite-quartzite that almost the whole of the underlying shales were removed and the Iron-ore beds occupy almost a basal position.

Sir Lewis discusses the outcrop of basal conglomerate immediately around the Deo river section as if it were a problem. There is no problem to those of us who have followed this bed along the strike—I personally have mapped it for over 30 miles where it is found continuously between the granite and overlying shales and limestones. There is, however, a problem in regard to the adjacent Singhbhum granite. Most of this granite is definitely intrusive into the Iron-ore series, but I am of the opinion that some of the granite intrusive into the Older Metamorphic system is older than the Iron-ore series. Most of Sir Lewis' difficulties arise from the fact that his acquaintance with the geology of this area is based largely on a traverse of the copper belt and on a few brief visits.

Continuing these surveys to the west, in Gangpur State, Dr. Krishnan has recently found a suite of calcareous rocks which he calls the Gangpur series, and which he believes is older than the Iron-ore series, but younger than the Older Metamorphic system. Recognising the several erosion intervals within the Iron-ore series, some of which have been very prolonged, and having surveyed the country up to the border of Krishnan's area, it seems to me possible that the Gangpur series may represent a stage (not necessarily basal) of the Iron-ore series (or system) elsewhere removed. However, discussion of this may be preferably left until Krishnan's memoir appears and his evidence can be more fully appreciated. Sir Lewis Fermor would correlate the Gangpur series with the Sausar series of the Central Provinces—still, 350 miles separate the two areas and correlation at this stage seems to be mere speculation.

Fermor remarks that in 1929 I discussed the possibility of correlating the Singhbhum rocks with the Dharwars of South India, following my predecessors. I no longer do so, however, for I regard such correlation as premature. Sir Lewis commences by accepting them as Dharwars, then sets out to prove his correlation.

At the end of each chapter the features of the province described are summarised and the lithological resemblances indicated on which a correlation with other areas may be suggested. These lithological grounds

reach a maximum for the Singhbhum-Orissa Province. They include such rocks as iron-ore deposits, hornblende-schists, aluminous rocks, manganiferous rocks, calcareous rocks, carbon phyllites, ultrabasic rocks, and granophyres. Of the iron-ore deposits similar rocks must have occurred in the Older Metamorphic system, as also do hornblende and other schists, and ultrabasic rocks. Of the manganiferous rocks we have at least two horizons in the Iron-ore series, either of which could have given rise to gonditic types under suitable metamorphism, and there are also the manganese deposits in the Gangpur series. Calcareous rocks are present in the Iron-ore series, sometimes thick but impersistent in this area—it is easy to visualise their swelling to the proportions known in the Gangpur series. Carbon phyllites are present in both Iron-ore and Gangpur series; it is not correct to say they are less important in the Iron-ore series, as Sir Lewis believes. As to the intrusive granophyres, from pebbles in the Iron-ore series there was a pre-Iron-ore granophyre, another is intrusive into the Iron-ore series and yet a third is an acid differentiate of the much later Newer Dolerites—microscopically identical with each other. These rocks provide no reliable evidence and I, personally, cannot accept any correlation on lithological grounds. To geologists not familiar with our Indian Archæan geology there is the possibility that resemblances marshalled in this way may appear to masquerade under the guise of logical premises. Time after time colleagues working with me in my area or in other areas have discussed with me these lithological similarities to the Iron-ore series rocks, but in recent years I have believed it wiser to put a brake on this type of correlation, and await the accumulation of evidence which will form a more logical basis. The field of comparative stratigraphic succession should prove a valuable aid, however, and there are signs of its ultimate use in Fermor's account.

It appears that Fermor's correlation, so far as his account has gone, is approaching lines similar to those which have suggested themselves to his colleagues, but which they have hesitated as yet to pursue.

In this review I have found it a little difficult to sift the principal features from the mass of detail irrelevant to the object of the memoir. Furthermore Sir Lewis has not always accurately recorded my less important views and I rather suspect the same on other minor points. I should like to have seen extracts taken from individual worker's own memoirs wherever possible rather than from General Reports; this particularly applies to the memoir of H. C. Jones which was in Sir Lewis' hands some three or four years ago.

J. A. DUNN.

ASTRONOMICAL NOTES.

Comet 1936 C.—The Third Comet of the year was discovered on the night of September 20, 1936, by Mr. Jackson at Johannesburg, and a day later, independently by Prof. Neujmin at Simeis, Crimea. The comet was of the the 12th magnitude at that time and near its maximum brightness, but seems to have faded rapidly declining to about the 14th magnitude on October 12. Mr. Jackson has computed a preliminary orbit from three observations and finds the time of perihelion passage to be 1936 October 2.

Another New Star in Aquila.—Another Nova in the Constalllation Aquila (Nova 668, 1936) was found by Prof. Tamm from examination of photographic plates taken at the Stockholm Observatory. The magnitude on October 7 was 7·6 and the position is given by

R.A. $19^h\ 23^m\cdot5$; Decl. 7° 29′ N. (1936·0).

The star is getting gradually faint, its magnitude on December 2 was estimated to be 9·4.

Two New Stars.—A nova was discovered on September 18, in the Constellation Aquila by Tamm, a Swedish astronomer, when its magnitude was 8·0. Its position (for 1936·0) is given by R. A. $19^h\ 14^m\cdot0$.; Decl. 1° 36′ N. The star was already decreasing in brightness, its magnitude on September 23 having declined to 8·8. There seems to have been a secondary maximum since then, and the brightness on November 3 was observed to be again $8^m\cdot0$. Information has been received of the discovery of a nova on October 6 by Mr. C. Jackson of the Union Observatory, Johannesburgh, South Africa. The star is situated in the Constellation Sagittarius and was about the sixth magnitude at the time of discovery.

T. P. B.

CENTENARIES.

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Jonh Maurice Brühl (Count), 1736-1809.

J. M. BRÜHL, the German diplomat, who made a name as an amateur astronomer, was born at Wiederan in Saxony on 20th December 1736. He was a nephew of Count von Henry Brühl, the Saxon minister, whose establishment of 200 servants was larger than the King's and about whom Frederic II said "Of all men of his age, he had most watches, dresses, lace, boots, shoes and slippers." This amazing collection of watches seems to have had a profound effect on his nephew. For, it is claimed that the most signal benefit conferred by J. M. Brühl on Science was his zealous advancement of chronometry.

His Career.

Having received his education at Leipzig, Brühl entered diplomatic service at the age of nineteen. Having seen service at Paris, Warsaw and Thuringia, he took up the post of envoy extraordinary in England in 1764 and stayed there till his death.

His Service to Astronomy.

Brühl loved astronomy with passion. In association with astronomer von Zash, he determined the latitudes and longitudes of several places, with a Hadley's sextant and a chronometer of Emery. The results were embodied in a book published in 1786. It gave the latitudes and longitudes of Brussels, Frankfort, Dresden and Paris. Another publication of his came out in 1794 under the title *On the investigation of astronomical circles*. He also contributed frequently to *Astronomisches jahrbuch*.

His Service to Chronometry.

As has been already stated, the impression produced in his youthful mind by the unusual collection of watches in his uncle's palace, made him devote much thought to chronometry in his later age. He published his *Three registers of a pocket chronometer* in 1785, his *Nouvean journal du chromitra* in 1786 and *A register of Mr. Mudge's timekeepers* in 1790. He was the acknowledged patron of Thomas Mudge, the famous British horologist, who is known to have made the first watch of Dr. Johnson in 1768 and to have invented the lever escapement. In his *A description of the timekeeper* (1799), Mudge explicitly acknowledged that the realisation of his improvements in watchmaking was largely due to the help of Brühl.

Brühl died at his house in Old Burlington Street, London on 9th June 1809.

John Johnstone, 1768-1836.

JOHN JOHNSTONE, a physician and a medical author, was born in Kidderminster in 1768. He belonged to a family rich in tradition. His father James was a famous medical doctor, who wrote a treatise on *The Malignant epidemic fever*. Two of his brothers also were famous in medicine. The eldest, James, distinguished himself by his thesis *De angina maligna*. The second, Edward, received well-deserved praise from the profession for his thesis, *De febre puerperali*, and got elected as the first physician of the Birmingham General Hospital. His nephew, James, became the first Professor of Materia Medica at Queen's College.

His Career.

John Johnstone became an M.B. of Edinburgh in 1793 and practised medicine in Worcester till 1799, when he removed to Birmingham, where he gained a large practice. He became M.D. in 1800, and a Fellow of the Royal College of Physicians in 1805. He was elected Harveian Orator in 1819. He was President of the second meeting of the Provincial Medical and Surgical Association by which name the British Medical Association first came into existence.

Johnstone's medical skill and general learning were considerable and his character was highly valued. He published six treatises on different topics in medicine. He died at Birmingham on 28th December 1836, aged 68.

Charles Frederic Chandler.

C. F. CHANDLER, the American chemist, was born at Lancaster, Mass., on 6th December 1836. His father was a merchant at New Bedford. While he was studying in the local school, he happened to listen to some occasional lectures on chemistry by Louis Agassiz. They roused his scientific curiosity and at fourteen he resolved to become a chemist and stuck to it. Even then he began to collect minerals and rig up a little chemical laboratory. In his

ardour for science, he neglected the classics and this stood in the way of his admission to the University. After spending some time in the Lawrence Scientific School at Harward, he crossed the Atlantic as supercargo on a sailing ship carrying whale oil to Antwerp. He spent three years at Berlin and Gottingen under Wöhler and Rose and got his doctorate in 1856.

His Career.

On return home, he sent a paper to the *Scientific American* on the preparation and use for lamps of mineral oil, but it was turned down on the ground that the use of mineral oil in lamps was too fantastic a notion for publication! Hearing that an assistant was required at the Union College, he went all the way to that place. But the trustees had sanctioned only a janitor's post. "I'll take the job of janitor" said the Doctor of Gottingen and without hesitation, he proceeded to sweep out and do general menial's work before and after hours for which he was paid and to assist the professor and to instruct in official hours for which he was not paid. It happened that the professor of chemistry left the college in a year and Chandler, the janitor, was made the professor. This was in 1857. He occupied the Chair of Chemistry of the Columbia University from 1864 to 1911. It is said that his students were like sons to him. He was jealous for their welfare. Much of his income went to help them. If his liberality was abused, he straightaway forgot all about it. As a mark of gratefulness, his old students established in his honour the Chandler Lectureship and the Chandler Medal for research in chemistry.

His Contributions to Science.

Chandler's early contribution to the study of illuminating oils has been already referred to. Later in life, when kerosene lamps became popular, fatal explosions were found to be frequent. He worked hard to avert such explosions and established proper standards of illuminating oils and a scheme of flash point tests. His work in this matter was so efficient that he was invited as an expert adviser by the British Government. When the New York College of Pharmacy was a struggling little school, he did considerable honorary teaching and developed it till it was taken over by the University. He became a leading authority on water-supply and sanitation. As early as 1866, he took up, as an honorary job, the regulation of the food supply and the sanitation of New York. He soon became a pioneer in municipal milk control. Another invention of his, which has now come into universal use, is the flush closet. He refused to patent this idea and allowed it to be exploited by anybody, so that more healthful homes might come into existence. In all his contributions, he never equated them with money or with any kind of personal advantage. He is indeed said to have been "One of the most effective crusaders of his time in behalf of the public good."

In the field of applied chemistry, he made leading contributions to the sulphuric acid industry and in 1866 he discovered the ingeneous system of ton-weight assaying, which is now in general use.

His Honours.

Chandler was a prominent member of the American Chemical Society, and of the National Academy of Sciences. He was an active member of several other American Societies, and of the Chemical Societies of several foreign countries. The collection he had made through his long life became the nucleus of the Chandler Chemical Museum of Columbia. He was greatly respected in scientific circles. His presence was always felt to be a joy and inspiration to others. The most difficult tasks became easy in his presence. He is described as a catalyst to encouragement, for he is said to have had a remarkable faculty in making men believe in themselves.

He died in his eighty-ninth year, on August 25, 1925.

RESEARCH NOTES.

Arithmetical Investigation of Elliptic Integrals.—Schneider (*Math. Ann.*, *Band* **113**, Heft 1, pp. 1–13) has proved three general theorems from which a variety of interesting results concerning the transcendency of elliptic integrals can be deduced. These are the following: I.—The six numbers a, b, g_2, g_3, $\wp(\beta)$, $a\beta + b\zeta(\beta)$, $\{\wp(\beta),\ = \infty, |a| + |b| \neq 0\}$ cannot all be algebraic. II.—If $\wp(x)$ and $\wp^*(\alpha^x)$ be algebraically independent and $x = \beta$ not being a pole for either, then at least one of the seven numbers g_2, g_3, g_2^*, g_3^*, $\wp(\beta)$, $\wp^*(\alpha\beta)$, α, is transcendent. (These theorems are slightly sharpened by him by utilising the transformation $\beta' = \lambda\beta$.) III.—If $\wp(\beta) \neq \infty$ and g_2 and g_3 are algebraic, then at least one of the three numbers $\wp(\beta)$, $\alpha \neq 0$, and $e^{\alpha\beta}$, is transcendent. The proof consists in constructing a polynomial

$$L(x) = \sum_{\lambda=0}^{n-1} \sum_{\mu=0}^{n-1} C\lambda\mu\ \wp^{\lambda}(x).[ax + b\,\xi(x)]^{\mu}$$

which r-ply vanishes at the points $a_k = k.\beta$ ($k = 1, 2, \ldots t$, under the supposition that if $\wp(k\beta) = 0$, the corresponding a_k is omitted), where $t = 2ts + 1$, and s is the degree of the algebraic field to which the numbers belong (assuming that all the sets of numbers in the theorems to be algebraic) in such a way that the coefficients c are all algebraic integral and all their conjugates are

$$< K_3^r \cdot r^{2r}, \quad \text{where } r = \left[\frac{n^2}{2t}\right]$$

This is constructed by making use of the formulæ and some inequalities of elliptic functions. Then he proves that if $L(x)$ possesses these properties, then it should be identically equal to zero by which the theorem is obtained.

The results obtained are extremely general and a few particular results are stated below: (1) The length of an arc of an ellipse whose axes-lengths are algebraic between algebraic values of the ordinates cannnot be algebraic. (2) In case g_2 and g_3 are algebraic $\omega, \eta, \omega/\eta, \omega/\pi$, are all transcendental. (3) If $J(\tau)$ is algebraic, then τ is either imaginary-quadratic or transcendental. (4) α and $\wp(\pi\alpha)$ cannot both be algebraic.

K. V. I.

Series-Developement in Invariant Theory Particularly in the Quarternary Field.—B. L. Vander Waerden (*Math. Ann.*, **113** Band, I Heft, 14-35) has obtained important generalisations of some fundamental results in the theory of invariants and has proved some unproved results of Gordan. In this article he builds up the theory of invariants and covariants of any system of *group-numbers* (*i.e.*, *Gruppen-Grose*) with respect to any group of transformations. As he presupposes a bare acquaintance of the theory of representations of groups, the article can be read with profit by those wishing to learn the modern conceptions of invariant theory and the beautiful and simple modern proofs of the results. (A synopsis of the foundations is given in Weyl—Group-theory and quantum-mechanics, Ch. III).

At the outset he defines a group-number as any quantity which is transformed linearly by the operators of a group G, *viz.*, vectors, tensors, spinors (in connection with the orthogonal group), linear forms in any number of variables, etc. We obtain therefore a representation of the group with respect to a group-number. A covariant of a group-number f (or a system of numbers) is another group-number whose elements are homogeneous polynomials of those of f which is transformed in the same way as f. The fundamental problem of covariant theory consists in finding a process of building up of all the covariants of a given system. This problem is resolved finally to the problem of expressing the product of two irreducible representations of a given group in terms of the irreducible representations of the group. The true significance of the Clebsch-Gordan series of the classical theory of invariants is that it gives us the product of two irreducible representations in terms of the irreducible representations of the linear group. An invariant is obviously a covariant corresponding to a space of order one. First of all the (linearly independent) linear invariants of a homogeneous form

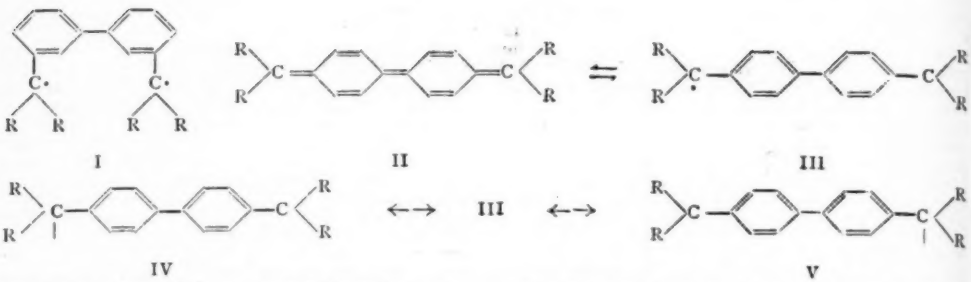
$$f = \sum a_{r_1 r_2 r_3 \ldots r_k}\ x_1^{r_1}\ x_2^{r_2} \ldots x_k^{r_k}$$

are found out as follows. The group induces a representation with respect to the form f. Now if this representation is resolved into irreducible representations, the number of linearly independent invariants is easily seen to be, equal to the number of irreducible representations of order one occurring in the representation f. The number of linearly independent linear covariants of f is easily seen to be equal to the number of irreducible contra-gredient representations of order k (assuming k to be the number of variables in f) occurring in the representation f. Invariants and covariants of higher orders involving higher powers of the coefficients of f are obtained by resolving the powers (formed in the Kronecker-way) of the representation f. (The process is called the polar process.) It is easily seen that the process gives not only the number but the invariants and covariants themselves.

In the latter part of the article he considers the special linear group and particularly the quarternary forms. Making use of the connection between the irreducible representation of this group and the corresponding permutation group (*i.e.*, the Frobenious-Young theory) he deduces many important results in particular generalisations of some of Study's results in the ternary case and some results given without proof by Gordan.

K. V. I.

Valence-Tautomerism in Unsaturated Compounds.—It is known that the presence of uncompensated single electrons in organic compounds such as in the mono radicals triphenyl-methyl or tribiphenyl-methyl, makes them paramagnetic. The same paramagnetism has



I II III

IV V

also been observed in a typical bi-radical, *viz.*, *m, m'*-Diphenylene-bis-(diphenyl methyl) I. One should expect on similar grounds that the mesomeric form III of tetra phenyl-dimethylene-diphenoquinone II, which is the *p*-analogue of the *m*- bi-radical and shows chemically a bi-radical nature, must also be paramagnetic.

The observed diamagnetism of this compound is therefore very striking and indeed E. Müller has pointed out that in all bi-radical compounds which can be mesomeric with a quinonoid structure, only diamagnetism is to be found. In the observed bi-radical form therefore it must be postulated that the spin of the two lone electrons in the two separate atoms must be compensated, and this would mean a new kind of chemical binding. B. Eistert (*Ber.*, 1936, **69**, 2393) has discussed this difficulty and explains that these two electrons responsible for colour and unsaturation, are not separate but paired as indicated by the observed magnetic property and that the paired free bond is alternately on either of the two methyl C-atoms, the structures III, IV and V being in quantum-resonance.

A number of other similar cases are also discussedi n this interesting paper.

M. A. G.

Contact Potentials of Reversible Soluble Films of Lauric Acid.—The accumulation of surface-active solute molecules on a freshly swept surface of solutions of benzopurpurin and nonylic acid has been studied by Doss (*Curr. Sci.*, 1935, **4**, 405; *Proc. Ind. Acad. Sci.*, 1936, **4**, 97). A similar observation has been made by Harkins and co-workers (*Nature*, 1936, **138**, 405), with saturated solutions of lauric acid by measurement of the variation of surface pressure and contact potential with time. Upon sweeping the surface rapidly the surface-active molecules slowly accumulate by diffusion from below with a rise in the surface pressure by about 6 dynes per cm. and fall in contact potential by 120 m.v.

Upon compression the surface pressure may increase to about 25 dynes per cm. and the contact potential may drop to − 200 m.v. which return to the equilibrium values, in about half an hour owing to the diffusion of molecules of the compressed film into the interior.

The observations indicate the importance of time factor in the determination of surface tension of solutions of surface-active substances and the imperfectness of the dynamic methods for determination of surface potentials.

K. S. RAO.

The Role of Certain of the So-called Non-Essential Elements in Plant-Growth.—The response of wheat grown in water cultures to the elements cobalt, iodine, zinc, aluminium, manganese, lithium and sodium supplied in the form of their chlorides is the subject of a study by B. N. Singh and S. Prasad (*Ind. Jour. of Agric. Sci.*, **6**, Part III). The culture solutions contained these compounds in four different concentrations, *viz.*, ·01M, ·005M, ·0005M and ·0001M. In addition to the growth characters recorded estimations were also made of the dry matter, the different carbohydrates, and the nitrogen content. The first two strengths have proved toxic while the second two have had a stimulating effect in all cases except NaCl in which the effect has been quite the contrary, *viz.*, the highest strength was stimulative, the second less so, the third not stimulative at all and the last slightly retarded the growth. $ZnCl_2$ was remarkable in the stimulative effect, growth being very vigorous and the dry matter yield also higher than in the controls. The chlorides of cobalt and iodine were found to be the most toxic, even the lowest strength was not free from toxicity. As regards the accumulation of carbohydrates, the effect is very varied; the sucrose content is in almost all cases below the controls; the starch content, in the majority of cases is higher than in the controls; the glucose was either just equal to or less than the controls except in the case of NaCl where it was greater; the total carbohydrates in the case of Na, Li, Zn and Mn. were higher at the stimulative strengths. The nitrogen in practically all the cases was lower except in the case of $ZnCl_2$ at the higher strengths which however are toxic strengths. On the whole it is difficult from these experiments to stress the importance of any of these elements, as the stimulative and beneficial effect in one direction appears to be counteracted by the baneful effect in other directions.

Quality of Lint in Relation to Ginning Factors.—The effect of changes in the setting of the moving knife in a roller gin and of different speeds in a saw gin on the quality of the resulting lint has been studied by Nazir Ahmad and R. P. Richardson (*Tech. Bull. Series A.*, No. 31, of the Indian Central Cotton Committee Technological Laboratory). The studies relate to two adjustments in the roller gin, *viz.*, an overlap of $\frac{3}{8}''$ and $\frac{4}{8}''$ for some and $\frac{4}{8}''$ and $\frac{5}{8}''$ for some others of the nine samples of cotton studied, while the saw gin speeds were 325 and 425 r.p.m. for all the samples. The latter comprised types of long,

medium and short staple cottons ranging from 0·70 to 0·94 inches of mean fibre length. It is concluded from the results that in respect of the important quality factors staple length and strength of yarn, and in cleanliness, the smaller overlap in the roller gin and the lower speed in the saw gin were more beneficial than the larger overlap and the higher speed. Better out-turns however resulted from the larger overlap and the higher speed, so that it looks as though the interests of the ginner, and the millowner looking for better quality, cannot both be served at the same time by any particular setting of the gin. The larger overlap also gave the higher ginning percentage with the majority of the varieties, but in the saw gin neither of the speeds made any appreciable difference; likewise no difference was made in the yarn neppiness by any of the adjustments of either the roller or the saw gin. The complexity of the factors involved in a study of this kind due both to ginning methods as well as to the character and condition of the seed cotton is referred to and the present study is stated to be the first of a series. We would at this stage ask the authors to consider if it will not be possible without sacrificing accuracy to carry out these tests with actual Factory units and thereby make the results applicable directly to ginning factory practice.

A. K. Y.

Cytological and Morphological Researches in Some Indo-Malayan Loranthaceae.—A paper of great interest, concerning one of the three recent works on Loranthaceæ, based on material collected by Prof. A. Ernst and his wife, Dr. M. Ernst-Schwarzenbach, during their botanical excursion to the Indo-Malayan region in 1930–31, has recently been published (Rauch, Konrad von, "Cytologisch-embryologische Untersuchungen an *Scurrula atropurpurea* Dans. und *Dendrophthoe pentandra* Miq.," *Ber. Schweiz. Bot. Ges.*, **45**, 5–61).

The development of the male gametophyte proceeds in a normal way. The tapetal cells are mostly uninucleate and the mature pollen grains are 2-nucleate. In both species the diploid number of chromosomes is 16 and haploid 8.

The development of the gynœcium shows some extraordinary phenomena. As in other Loranthaceæ, investigated by older authors, ovules in the usual sense are absent. There are no integuments and even the nucellus is not marked out from the surrounding tissue of the inferior ovary. There is a many-celled archesporium; the number of megagametophytes varies from 3 to 5 in *Sc. atropurpurea*, but goes up to 12 in *D. pentandra*. The embryo-sacs elongate considerably both upward and downward. Their progress on the lower side is soon checked by a layer of collenchymatous cells, but the upper end continues to grow aggressively and penetrates far up into the stylar canal—in *D. pentandra*, where the style has an average length of 15.5 mm., one embryo-sac was only 4.5 mm. below the stigma! Protrusions of nucelli and embryo-sacs into or through the micropyle have, it is true, been recorded before in other angiosperms, but such an extreme case is not known outside its family. Indeed, the downcoming pollen tubes and the up-growing 'embryo-sac-tubes' offer, in the opinion of the reviewer, a parallel to the condition in *Welwitschia*, although the two plants are too differently related to permit much speculation. Double fertilisation occurs in the usual way, but this event takes place in the style and not in the ovary! The endosperm seems to be cellular from the very beginning. The first division of the egg is longitudinal, followed by some transverse divisions, resulting in a 2-rowed suspensor and a bi-celled embryonal primordium at the tip. In the mature fruit only a single embryo is present, since the others degenerate at one time or the other during the course of their development. By a fusion of neighbouring embryo-sacs the different endosperms become united to form a common nutritive mass for the surviving embryo.

Dr. Rauch's work is of more than usual interest and readers would consequently have welcomed a more detailed account of the earlier development of the embryo-sac. The statement—"es werden drei Makrosporen gebildet, von denen die oberste zum Embryosack auswächst"—is ambiguous. Strictly speaking, a row of "three megaspores" does not occur at all, for one of the three must be a *dyad cell* that has failed to undergo the second reduction division. Whether the uppermost cell, in this case, is a dyad or a real megaspore, is not made clear by the author, and so it is impossible to say if the development is of the "*scilla*-type" (it would be more correct to call it the "*Allium*-type," since it was first discovered in *Allium fistulosum*) or Normal-type.

A study of the embryology of some Indian Loranthaceæ is now being carried on at Cuttack in Prof. P. Parija's laboratory and the results thereof will be awaited with keen interest.

P. MAHESHWARI.

An attempt to use the structure of the generative cell as an aid in the solution of systematic problems (Wunderlich, *Öster. Bot. Zeit.*, 1936, **85**, 30–55) has been made by Miss Wunderlich. She herself calls it only an attempt, since the aceto-carmine method, which she employed, does not give good results in every case.

It has been found that, as a general rule, species of the same sub-tribe show a similar structure of the generative cell and nucleus. Since it is quite impossible to mention all the details, the reviewer is citing just one instance here. In the tribe Asphodeloideæ, members of the two sub-tribes Asphodelinæ and Anthericinæ were investigated. In *Asphodeline lutea*, *A. liburnica* and *Eremurus spectabilis* (Asphodelinæ) the generative plasm could not be made visible but the long thin generative nucleus stained well. In *Paradisia liliastrum*, however, which is included by Krause in the same sub-tribe, a spindle-shaped generative cell was clearly visible and the generative nucleus was found to be broader and shorter than in the other two genera of this sub-tribe. A similar structure of the generative cell was seen in the sub-tribe Anthericinæ in 3 species of *Anthericum*, in *Chlorophytum Sternbergianum* and *Echeandia terniflora*. On the other hand, *Bulbine caulescens* (placed by Krause in the Anthericinæ) showed a structure comparable to that in *Asphodeline* and *Eremurus* (Asphodelinæ). Miss Wunderlich concludes from this that the genus *Paradisia* ought to be transferred to the sub-tribe Anthericinæ and *Bulbine*,

on the other hand, to the Asphodelinæ. This is in accord with the conclusions reached by Stenar (1928) and Schnarf (1929, 1931) on embryological grounds.

It may be noted that in some cases (*Haworthia, Fritillaria, Tulipa* and *Ornithogalum*) the generative plasm could be seen even in the unstained pollen grains mounted in water. The reviewer can add to these *Hippeastrum hybridum* (Amaryllidaceæ) from his own experience.

It is to be commended that the author is very cautious in her conclusions. In those cases where the generative plasm was not stained with aceto-carmine, she does not conclude (like some other authors!) that *it did not exist at all*, but that *it could not be made visible*. The same care is exercised in statements with regard to the existence of the vegetative nucleus. In species of *Allium* it stained as deeply as the generative nucleus itself, in some other cases it stained very lightly, while in still others where it could not be stained at all, Miss Wunderlich avoids the usual (and hasty!) conclusion that it had degenerated.

H. D. WULFF.

Fossil Algae from the Trichinopoly Cretaceous-S. India.—About 5 years back, in August 1911, Prof. L. Rama Rao reported through the columns of *Nature* the discovery of numerous algæ in the uppermost Cretaceous beds (the Niniyur group) of the Trichinopoly District, S. India. These have now been studied by Dr. Julius Pia of the Natural History Museum, Vienna, who is a well-known authority on fossil algæ and the results published in a recent *Memoir of the Geological Survey of India* (*Pal. Ind. N. S.*, **21**, 4) under the joint authorship of Prof. L. Rama Rao and Dr. Julius Pia. In part I of this memoir, Prof. Rao has given a detailed account of the geology of the Niniyur group, with special reference to the algæ-bearing rocks. The flints and cherts associated with this group have been proved to be the result of silicification of limestones, which they resemble both in general appearance and the character of the included fossils. Regarding the mode of origin of the Niniyur rocks, it has been shown that they were deposited during a local and independent post-Senonian transgression of the sea in the north-eastern part of the Trichinopoly Cretaceous area, and are of Mæstrichtian-Danian age. In part II, Prof. Pia describes the fossil algæ present in these rocks—cheifly belonging to the four families: Solenoporaceæ, Corallinaceæ, Dasycladaceæ, and Chætophoraceæ. Of these the most important from a botanical and stratigraphical point of view are the Dasycladaceæ, of which several new genera and species have been described. Of the Corallinaceæ the most common form is Archæolithothamnium. The general character of the Niniyur algal flora suggests an age transitional between the Cretaceous and Eocene systems. While these algæ cannot be employed to decide stratigraphic questions in this area, the sequence of strata in this region will be a typical section, and the algæ could be used to correlate strata in other parts of the earth with those in the Trichinopoly District and thus to fix the geologic age of these foreign sediments.

Growth of Colpidium in Relation to Certain Incomplete Proteins and Amino Acids.—Hall and Elliott (*Arch. f. Protistenk*, 1935, **85**, 443) have demonstrated that growth of Colpidium is accelerated by several amino acids and asparagin when each of these substances is added to a medium which supports a relatively slow but steady growth of ciliates. The addition of a series of single amino acids and asparagin to a gelatin medium produced increases in growth ranging from 20% to more than 50% than in the gelatin controls. These authors therefore suppose that Colpidium is able to make use of a number of single amino acids, although none of them alone is adequate for growth of the ciliates. A combination of gelatin and a very small amount of yeast extract or liver infusion or tryptone supports the growth of ciliates continuously which does not happen in gelatin alone.

M. K. S.

Studies on the Physiology of the Euglenoid Flagellates. V. The Effect of Certain Carbohydrates on the Growth of *Euglena gracilis* Klebs.—The effect of various carbohydrates upon the growth of *Euglena gracilis* in bacteria-free culture has been studied quantitatively (Jahn, *Arch. f. Protistenk*, 1935, **86**, 238). When transferred from an inorganic medium to one containing carbohydrate in addition to inorganic substances *E. gracilis* undergoes encystment or an acceleration or deceleration of division rate. The effect varied with the carbohydrate used and also to some extent by the physiological condition of the stock cultures, intensity of light, temperature and the pH of the medium. *E. gracilis* does not secrete sucrase or amylase.

M. K. S.

Isolation of *Glaucoma ficaria* Kahl in Bacteria-Free Cultures, and Growth in Relation to the pH of the Medium—Growth of *Glaucoma ficaria* occurs within the pH range of 4.9–9.5 and that of *G. piriformis* within the range of 4.0–8.9 (Johnson, *Arch. f. Protistenk*, 1935, **86**, 263). In general the pH optimum is somewhat lower for *Glaucoma piriformis* (4.8–5.3) than for *G. ficaria* (5.1–6.0). The type of growth-pH curve for either species depends upon the type of medium used.

M. K. S.

Growth of *Glaucoma ficaria* Kahl in Cultures with Single Species of Other Micro-Organism.—Johnson (*Arch. f. Protistenk*, 1936, **86**, 359) has successfully cultured *Glaucoma ficaria* in suspension of 21 species of living bacteria, one species of living yeast, and one species of algæ; in suspension of 11 species of dead bacteria, a species of dead yeast and 6 species of dead flagellates. The usefulness of yeast and small Protozoa as food for *G. ficaria* depend largely upon the size of such organisms, the larger forms not being ingested by the ciliates. In suspensions of Bact. (Erythrobacillus) prodigiosus the division rate of *G. ficaria* was approximately the same from pH 4.5 to pH 8.6 while in suspension of three other species of bacteria the ciliates showed a bi-maximal growth-pH curve with maximal development at pH 5.0 bis 5.2 and at pH 7.6.

M. K. S.

Nutrition and National Health.*

IN his three Cantor Lectures Sir Robert McCarrison expounds, with clarity and eloquence, the faith of the modern student of nutrition. He is not the type of scientific worker who ignores the wood in contemplation of the trees, or of a particular leaf on a particular branch of a particular tree. He never loses sight of the fundamental fact that well fed animals are strong and healthy and largely escape disease, while badly fed animals have a low vitality and poor physical development, and suffer from all manner of diseases which orthodox medicine ascribes to multifarious causes. It is an interesting reflection that hitherto man has not succeeded, except perhaps in rare instances, in achieving a thoroughly satisfactory adaptation to his environment in the matter of food. The "natural" diet of the savage is far from ideal; that of the grain fed peasant, who still forms the majority of the human race, still less so. Even the pastoral peoples do not achieve dietary perfection. Civilisation was made possible by the discovery and cultivation of cereal and leguminous plants producing food which can be stored in bulk. But plant seeds, even when unmilled, are not entirely suited to form the whole food of the human organism. The perfect human diet, in the modern sense, includes in addition to seeds a food which seems quite "unnatural," the milk of another species, and vegetables and fruits which have come into common use only in the last few centuries and which until quite recently were scanty except in certain seasons. The human infant in the temperate zone seems to require, for optimum development, a substance —vitamin D—obtained by organised industry from the liver of fish or produced by the artificial irradiation of foods. A perfectly nourished people would be a *new* creation, as much a product of experimental and applied science as television is a product of experimental and applied science. It would represent adaptation to environment on a different plane to that hitherto attained by man in his struggle to obtain enough food for mere survival.

Sir Robert McCarrison has done as much as any man to further this adaptation. In his lectures he describes various experiments which have led us to a realisation of the importance of proper diet. One striking experiment which was carried out in Coonoor is described.

"Many years ago (1918) when the newer knowledge of nutrition was in its infancy, I obtained some dozens of healthy monkeys from the jungle of Madras. Some I fed on faulty and ill-balanced food deficient in vitamins and mineral elements, others on perfectly constituted food. The latter remained in good health; the former developed gastro-intestinal ailments, ranging from gastritis and ulcer to colitis and dysentery, while one amongst them had a commencing cancer of the stomach. The passage of years has not dimmed the recollection of this crucial experiment nor detracted from the far-reaching importance of the results yielded by it. Indeed, there is, perhaps, no more significant fact in regard to the function of nutrition than that this highly specialised alimentary mechanism on which the nourishment of the body depends is itself among the most susceptible of the structures of the body to faulty nutrition."

(It is said that the descendants of the monkeys used in this experiment, or of those which survived to be subsequently liberated, still roam the woods and jungles in the neighbourhood of Coonoor. But that is by the way.)

The third lecture of the series deals with nutrition in relation to national health. The lecturer points out that in England standards of health and physique are far from satisfactory and that great improvement might follow the increased consumption of "protective" foods such as milk and green vegetables. He quotes the experience of Sir Pendrill Varrier-Jones at the Papworth Village Settlement for the subjects of tuberculosis "In this village of 400 persons no child born there during the twenty years of its existence has, while a member of the community, contracted tuberculosis of the lungs, bones, joints, cerebral membranes, nor indeed any clinical form of the disease. Yet these children are the offspring of parents who suffer from tuberculosis and are in constant contact with them." One of the most important factors in bringing about this remarkable result is that the diet of young children born in the village has been carefully supervised.

Sir Robert McCarrison declares that Miss Margaret McMillan's book *The Nursery School*, which describes the regeneration of children of the poorer classes by good feeding and careful management, should be "an obligatory text-book for every student of medicine." He conveys here and there the suggestion that orthodox medicine, as taught in the medical schools, has been slow to adapt itself to changing views about health and disease. The now obvious fact that a large proportion of disease has its primary cause in poverty, which is associated with all manner of environmental stresses and in particular with diet deficiency, should certainly be more generally realised. Improvement in the health of a people runs parallel with improvement in their economic condition. The efficiency or otherwise of curative medicine is a factor of minor influence, however important it may be to the comfort and happiness of the individual.

W. R. A.

* "Nutrition and National Health." Major-General Sir Robert McCarrison, C.I.E., M.D., D.Sc., LL.D., F.R.C.P. Cantor Lectures. *The Journal of the Royal Society of Arts*, 1936, **34**, 1047-83, 1087-1106.

World Production of Mineral Oils.

THE increasingly important role which mineral oils have assumed in the life of Nations, in peace and in war, coupled with the periodic prophesies in the daily press of an impending petrol famine, lend interest to a sober analysis of the present situation by Dr. Oscar Zaepke in *Forschungen und Fortschritte* (1936, **16**, 209). Dr. Zaepke finds that while the mineral oil output of the world sank from 211 million tons in 1929 till 1932, it rose again gradually to 209 million tons in 1934 and to 226 million tons in 1935—the highest annual output in world production. The important mineral oil producing countries of the world and their individual quotas during the peak year (1935) make very interesting reading.

Dr. Zaepke considers that any estimate of the available total supplies in the world for future use would be misleading for a number of reasons. The potential oil fields of the world have as yet not been completely surveyed. The technique of tapping is continually improving till, to-day, it is possible to tap very nearly *all* the oil in a given locality. Further, progress in other branches of applied science, as for example the development of the Bergius, Franz Fischer, and Tropsch processes, are continually enriching the amount of raw material from which petrol or its substitutes can ultimately be obtained. These facts lead Dr. Zaepke to deprecate unwarranted attempts to create scares about the world mineral oil position.

The geographical distribution of mineral oil is, however, quite another matter and cannot be fully gone into here. At one end of the picture is England who must cover her enormous demand exclusively by imports and at the other end is Venezuela whose (nearly) entire production is dependent on export.

EMMENNAR.

WORLD PRODUCTION OF MINERAL OILS.

(*In* 1,000 *Tons.*)

Country	1935	%	1934	%	1933	%
U. S. A.	135 487	59·9	123 693	59·2	123 266	62·3
Russia	24 005	10·6	24 151	11·5	21 434	10·8
Venezuela	22 211	9·8	20 427	9·8	17 553	8·9
Rumania	8 359	3·7	8 473	4·1	7 387	3·7
Iran (Persia)	7 480	3·3	7 537	3·5	7 086	3·6
Dutch East Indies	6 000	2·7	5 971	2·8	5 392	2·7
Mexico	5 956	2·7	5 614	2·7	5 000	2·6
Iraqu	3 550	1·6	861	0·4	118	0·1
Columbia	2 643	1·2	2 477	1·2	1 849	0·9
Peru	2 429	1·1	2 316	1·1	1 883	1·0
Argentina	2 129	0·9	1 995	1·0	1 957	1·0
Trinidad	1 672	0·7	1 583	0·8	1 385	0·7
India	1 406	0·6	1 290	0·6	1 227	0·6
Sarawak Brunei	671	0·3	660	0·3	622	0·3
Poland	515	0·2	529	0·3	551	0·3
Germany	425	0·2	315	0·2	239	0·1
Japan (incl. Taiwan)	257	0·1	245	0·1	2·3	0·1
Equador	243	0·1	259	0·1	216	0·1
Canada	187	....	89	....	150	....
Egypt	180	0·3	211	0·3	228	0·2
Bahren Islands	171		36		....	
Other Countries	143		150		139	
TOTAL	226 119	100·0	208 982	100·0	197 915	100·0

SCIENCE NOTES.

Central Laboratory to Evolve Standards for Drugs.—A definite step towards the standardization of drugs in India with possibilities of the tightening of control over the manufacture of spurious drugs is being taken in the establishment of a Biochemical Standardization Laboratory, for which orders have already been issued by the Government of India. (Press Note issued from the Director of Public Information, New Delhi, 6th Nov.)

The Laboratory will consist of a Bio-assay sub-section and a Pharmaceutical sub-section, and among its functions will be the preparation and maintenance of suitable standards of strength, purity and quality for drugs, and standardization of methods of analysis and test with regard to climatic and other conditions prevailing in different parts of India. The Laboratory will also act as expert referee in respect of disputed analysis of samples sent by local Governments, guide, co-ordinate and correlate the work of provincial laboratories, assay and test chemicals and drugs, and biological products such as serum and vaccines, and organo-metallic compounds at the request of Central or local Governments, and periodically issue bulletins about its progress in various branches of its activities, and supply information to manufacturers and Provincial laboratories as the need may be.

The Laboratory will, to commence with, be located at the All-India Institute of Hygiene and Public Health, Calcutta, and Bt. Colonel R. N. Chopra, C.I.E., I.M.S., Director, School of Tropical Medicine, Calcutta, will be responsible for its organization and direction in the early stages.

The staff of the Laboratory will consist, besides a number of assistants, in its Bio-assay sub-section of one Pharmacologist, two experimental Assistants, and in its Pharmaceutical sub-section of one Pharmaceutical Chemist, one Bio-chemist and two Assistant Chemists, and steps have already been taken for their recruitment.

It may be recalled that in March 1927, a resolution was adopted by the Council of State recommending that local Governments should be urged to take steps to control the indiscriminate use of medicinal drugs and for the standardization of the preparation and for the sale of such drugs. Accordingly, in consultation with the local Governments, a Committee was appointed, presided over by Bt. Colonel Chopra, to explore and define the problem of drug control and to make recommendations. The recommendations of this Committee were considered in consultation with the Local Governments, and action is now being taken to implement them.

* * *

Central Board of Irrigation, 7th Annual Meeting.—His Excellency the Viceroy opened the proceedings of the annual meeting of the Board, on the 31st October. In the course of his speech, His Excellency dealt with the importance of irrigation research in relation to the agricultural prosperity of the country. "We are all of us proud to think that India should possess an irrigation system which is the most important in the world to-day and I would like to take this opportunity to pay my tribute to the long line of distinguished engineers to whose labours that system is due, and who can claim to have contributed in the most material degree to laying the foundations of India's prosperity." The total amount so far expended on irrigation works approximate to Rs. 150 crores. That sum has been spent over a period of 80 years, and the system now serves an area which raises crops valued at more than 100 crores of rupees, annually.

Of the problems of vital importance to India to-day, not the least important is that of the food for her rapidly increasing population. According to a recent report of the Public Health Commission with the Government of India, the population of India is increasing at the rate of about 4 millions every year, and it is expected that by 1941 the population of India will be 400 millions! Only three-fourths of an acre per head of population in British India is under cultivation for food purposes, and while the Agricultural departments are investigating the means of increasing the productivity of the land, it will become apparent to every one that to keep pace with the increase in population large tracts of land must be brought under fruitful cultivation, and this can be effectively done by extending facilities for irrigation.

A recent development in the country and one of great importance is that of hydro-electric generating schemes on irrigation canals by the utilisation of power available at canal falls. Extraction of water from the sub-soil for the irrigation by means of electrically operated tube-wells is being undertaken on a large scale. The Ganges Canal Hydro-Electric Scheme in the United Provinces commands an area of 13,000 square miles and is capable of supplying electric power at cheap rates, primarily for irrigation and agricultural purposes.

One of the questions that came up for discussion at the meeting is that of the establishment of a Central Research Station for Irrigation. The work of the past ten years on problems of irrigation and river control with the use of models has shown the need for research of an all-India character. The establishment of such an Institute will be a matter of great importance to the progress of irrigation in India.

* * *

Meteorology in India.—Details of rapid strides made during the last twelve months and even more important developments pending are given in the Administration Report of the Meteorological Department of the Government of India for 1935–36.

Dealing with the Empire Air Mail Scheme, which is expected to come into operation during the next two years (according to a press note issued by the Director of Public Information). The Report states:—"At important stations along the route it will probably be necessary to maintain a service throughout the twenty-four hours, and at all intermediate stations for fifteen hours or more.

"The development will involve sending up illuminated balloons for the measurement of upper winds at night, search lights for determination of cloud heights, special arrangements for measurements of visibility at night, and provision of extra staff for night attendance.

"Night flying involves more or less blind flying, in which airmen need all the help they can get to navigate their machines safely, and in countries where night flying has developed to a considerable extent, such as Germany and the United States of America, there are meteorological stations on the routes 50 or 60 miles apart; in India, however, financial considerations will permit stations only at intervals of about 300 miles."

It is pointed out that air traffic has become regular between India, Siam, Malaya and Indo-China, and that the exchange of meteorological data with these and other countries has, therefore, become a problem of considerable importance. A regular broadcast of weather data from a powerful wireless station is necessary. It is noted that short-wave stations are being established at Rangoon and Calcutta, and that these will solve that problem.

In connection with the aviation weather service the Report states:—"The existing meteorological organisation in India for aviation is still far below the standard defined in the International Convention.

Progress was made in the study of the detailed distribution of rainfall in South India associated with storms. A new forecasting formula for winter rains, which promises to be an improvement, has been worked out by utilising the upper wind data of Agra.

The comparatively new section of Agricultural Meteorology is to be continued for a further period of two years for the present. Valuable investigations have been made in this section on the movement of moisture and heat through the air and soil, of solar and terrestrial radiation and other problems. Special attention was directed to problems relating to frost and cold wave warnings.

Another small but important activity is the co-operation with the Locust Research Entomologist which involves the supply of meteorological data required and the arrangement of frequent discussions about weather conditions.

It is interesting to note that besides the multifarious routine activities, the Department has had time to tackle a large number of research problems. A long list of such problems which received attention during the year is given—most of these are of considerable importance to the science of meteorology. Some of these researches are of immediate value to the utilitarian activities of the department.

* * *

Indigenous Tool Handles.—The annual consumption of Tool Handles by the Indian Railways and Government departments alone is estimated by the Imperial Forest Economist at some 2,000,000 handles. The bulk of this huge demand is met by import (mostly ash and hickory). The possibility of meeting at least part of this demand with indigenous woods is, therefore, of importance. Mr. M. N. Gallant, I.F.S., Forest Economist, Burma, gives an interesting account in *The Indian Forester* (October 1936) of the successful efforts made to introduce to the market Tool Handles of *Anogeissus acuminata*.

Preliminary experiments at Dehra Dun in 1925 indicated that *Anogeissus acuminata* was possibly superior to imported ash and hickory. During 1926–30, Tool Handles from kiln-dried *Anogeissus acuminata* were supplied, for test under work conditions, to the Great Western Railway, the Federation of British Industries and others in England. Much headway against conservatism and prejudice had to be made and it was not until 1933 that the South Indian Railway placed an order for a modest 3,000 handles of the wood. The same year the E. I. R. purchased 37,700 handles and since then the popularity and the demand for these Tool Handles have slowly but steadily developed. The Railway Board, Delhi, impressed by the very favourable reports from the consumers, are now investigating the possibility of erecting a large plant near Calcutta for supplying the requirements of several Indian Railways for these Tool Handles.

These pioneer efforts may be said to mark a new chapter in the utilisation of indigenous woods for Tool Handles in India.

EMMENNAR.

* * *

London Shellac Research Bureau.—We have recently received a copy of the *Annual Report* for the year 1935–36. The report commences with a frontispiece of the attractive window display at India House of the several articles arising out of lac. The fluctuations in the lac market are shown to be within narrow limits by the figures in the table of monthly imports and prices. Reference is made to the increased consumption of lac in Russia and Japan.

From the brief description of the work of the Special Officer, Lac Inquiry, it is quite evident that strenuous efforts have been made to further the causse of lac by propaganda in person and through the technical press. Great emphasis is laid on the marketing of genuine lac, conforming to a standard specification and the distribution of knowledge on the uses of lac. The rather alarming state of lac in the gramophone record industry is disclosed and it is linked to the fact that the gramophone is being rapidly replaced by the radio or radiogram. Figures are given to indicate the increased output of synthetic resins but they seem not to have spelt real danger to lac as yet, because the majority of synthetic resins are used in the positive moulds and for thermosetting moulding materials where shellac has not been found suitable.

The lac research programme in the United Kingdom is briefly outlined and reference has been made to the progress achieved in the various lines. It is pointed out that the co-ordination of the work of the London Shellac Research Bureau with the Indian Lac Research Institute and the New York Shellac Research Bureau could be enhanced by periodical meetings of the executives, instead of by mere correspondence.

It is gratifying to find from the report that the year under review has been a period of great activity and good deal of work has been carried out to stabilise the position of lac in the world market.

* * *

Rothamsted Experimental Station.—It is a pleasure to have the opportunity of recording another year of useful and intensive research in the several branches of agricultural science, carried on at the Rothamsted Experimental Station, Harpenden, England. The comprehensiveness of the subjects taken up for scientific

study at this centre, the oldest of its kind in the world, is evident from their *Report for* 1935, just received, which states that "the range of investigations includes the growth and composition of crops, the properties of soils, of fertilizers and manures, the conditions in which each can be used to the best advantage, soil management, plant diseases, insect pests, bees and other subjects." Though the Station first came prominently into public notice through its advocacy of the value of artificial fertilizers and its famous permanent manurial experiments on wheat, roots and barley, its activities have, since their inception in 1843, shown an ever widening horizon and at the present time much work of a purely scientific character is carried on in the several laboratories attached to the Station. In fact, the scientific reputation of the institution is so high that it has been attracting, year by year, leading agricultural workers and scientists from all parts of the world, who have found in Rothamsted a quiet haven best suited for intensive scientific studies.

It would appear from the *Report* that the results of 50 years' experimental work completed at Woburn from 1877 till 1928 are under publication, and the work of the Microbiology Department at Rothamsted has recently been published in a monograph entitled " Problems in Soil Microbiology " by Mr. Cutler and Miss Crump. Dr. Brenchley contributes to the present *Report* a useful summary of the last 30 years' work in the Botanical Department. One anticipates that the occasion of the centenary celebration of the Experimental Station in 1943 will be availed of by the authorities to place before the public comprehensive accounts of the work carried on by the Institution, since its inception, in the several branches of agricultural research in which the Station has been interesting itself.

The general arrangement of matter and get-up of the *Report* follows the lines of the previous volumes. One would however be surprised to note that the introductory part makes no reference to the recent purchase by the Station of the Rothamsted Estate and Manor House at a cost of £ 35,000 raised by public subscriptions. Recent visitors to Rothamsted will also miss in the engraving of the Laboratory given in the *Report* the Sun Dial which was prominently fixed in front of the main building last year.

C. N. A.

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The recent issue of the *Quarterly Journal of the Mining, Geological and Metallurgical Society of India* (Vol. VIII, No. 2) contains two articles on the heavy minerals of the Barakar and Raniganji sandstones of the Jharia coal fields. K. L. Bhola in the first article has described the heavy minerals, and has tried to correlate them with the granites, pegmatites and the garnet schists of the area. In the second article S. K. Roy and N. L. Sharma have published the results of the heavy mineral analysis of a number of samples. They have been tabulated and a geological map at the end shows the localities of the samples collected.

The council of the Mining and Geological Institute of India appointed in the year 1929 a Committee to go into the causes of subsidences and underground fires in coal fields. During the years 1929 to 1936 the Committee has collected a large amount of information from various collieries and mines in India. Very valuable geological data about dykes and faults affecting coal seams have also been reported. There are numerous sketches, sections and figures appended to the report which must be very helpful for all mining engineers and colliery managers.

* * *

The Journal of the Indian Medical Association.—With the publication of the September Number, the *Journal of the Indian Medical Association* completes the fifth volume. As its name indicates, it is the official organ of the Association and is issued monthly from Calcutta under the Editorship of Sir Nilratan Sircar, Kt., M.A., M.D., LL.D., D.C.L. The Association has a number of branches in the important centres of India, Burma and Ceylon, and a number of professional societies are affiliated to it. The Journal has a wide circulation consistent with its reputation. The number under notice contains an article by Drs. J. C. Gupta and S. K. Sen on the behaviour of Free HCl Curve in a Series of 100 consecutive cases of Gastric Content Analysis, with the idea of obtaining a clue for diagnosis. Dr. S. P. Gupta has contributed an article on the Hodgkin's Disease which manifest itself as a progressive glandular enlargement and as the diagnosis of this condition mostly rests on histological and biological examinations and as the facilities for these tests are not usually within the reach of general practitioners, the extent of this malady has not been gauged. There are other interesting articles including the one on Birth Control in India by Dr. A. P. Pillay, the Editor of *Marriage Hygiene*. Other features include, Case Notes, Notes from Current Medical Literature, Medical Notes and News, Association Notes and Book Reviews. We have no doubt that the Association with its useful activities has an assured future.

* * *

'Marriage Hygiene.'—This International Quarterly Journal of Sexology, issued under the Editorship of Dr. A. P. Pillay, has during the past two years of its existence published in its pages articles of international character, and has proved a real addition to the literature on Sexology. Its objects are (1) To secure for conjugal hygiene a proper place in preventive medicine by setting forth its significance and interactions on personal, domestic and social life and its importance for racial and national welfare. (2) To publish scientific contributions treating marriage as a social and biological institution, considering especially the factors and forces influencing its welfare. The problem will be discussed from the view-point of physiology rather than pathology and the emphasis will be on the normal rather than abnormal functions. The sociological, economic and legal aspects will not be neglected. (3) To promote, co-ordinate and unite the interests of contraceptive clinics and marriage hygiene consultation centres in various parts of the globe.

We understand that at the instance of Dr. Havelock Ellis, the editors have decided to enhance the scope of the Journal, by publishing in it special articles bearing on Sexology. The annual subscription of the Journal is Rs. 10, and we hope that this useful Journal will receive all the support from the scientists, it so richly deserves.

Royal Asiatic Society of Bengal.—At the ordinary meeting held on 7th December, the following papers were read: (1) A. Banerji, *A Buddha Image from Kurkihdr*; (2) A. H. Harley, *Abu Nukhailah, A post-classical Arab Poet*; (3) S. N. Chakravarti, *A Sculptural Lintel of Gupta Date from Sarnath*; and (4) G. E. Gates and M. Hla Kyaw, *The Clitellum and Sexual Maturity in the Megascolecinoe*. The following exhibits were shown and commented upon: (1) *Little-known Works of Two Celebrated Tantric Writers*, and (2) *A Valuable Manuscript of an Urdu Romantic Poem (Mathnawi)* composed by Sharaf-un-Nisa a lady of Murshidabad (Bengal).

* * *

The Nobel Prize in Physics for this year has been divided between Prof. V. Hess and Dr. C. Anderson. Prof. Hess discovered that the ionisation of air at an altitude of 5,000 meters was more than twice that found at sea-level, showing thereby that this ionisation was of inter-stellar or cosmic origin. Dr. Anderson is the celebrated discoverer of the positron, the antithesis of the electron.

The Nobel Prize in Chemistry has been awarded to Prof. Peter Debye, the well-known Mathematical Physicist, for his researches bearing on the structure of molecules.

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Mr. T. E. Parkinson, I.E.S., Director of Public Instruction, Punjab, has been appointed Educational Commissioner to the Government of India.

* * *

Official intimation has been received that the Senate of the London University at their meeting of 18th November 1936, conferred the degree of Doctor of Science on Dr. H. Chaudhuri, Head of the Department of University Teaching in Botany, and Director, Kashyap Research Laboratory, Punjab University.

* * *

New Research on Optical Glass at Mellon Institute.—A broad program of fundamental investigations on the chemistry and physics of glass surfaces to aid in the development of scientific apparatus and ophthalmic instruments has been started at Mellon Institute of Industrial Research by the Bausch & Lomb Optical Company, of Rochester, N.Y. The first studies will be concerned with the effects of environmental factors on the durability of the various types of glass used in optical instruments.

The Bausch & Lomb Optical Company, whose research in optical glass dates from the initial work of William Bausch in 1912, has maintained a fellowship at Mellon Institute since 1931 for research on various plant and production problems in optical technology. New developments in the past have included improved greases for optical instruments, cements for ultra-violet transmitting optics, improved methods for making and testing mirrors and reflectors, and standardization of the sizes of fine abrasives used in grinding lenses.

Dr. Frank L. Jones, the fellow since 1931, will be in charge of the new investigations of the Bausch & Lomb Optical Company at Mellon Institute. An enlarged staff will continue the work on plant problems at the new research laboratory of the company in Rochester.

* * *

Micromax Thermocouple Pyrometres.—A new 52-page catalog has been just issued by Leeds & Northrup describing "Micromax Thermocouple Pyrometers". The potentiometer method of measurement of the operation of the rugged, yet simple, mechanisms through which this balance method is made available to industry are well explained.

The new Silver-Anniversary Micromax, announced in the 25th year since this Company originated the recording potentiometer, is described in detail. This thoroughly modern machine keeps always visible ten inches of record, while a bold pointer enables the operator to read temperature at a glance. The instrument can be equipped also to operate signals and automatic controls, and is available for measuring not only temperature but CO_2, liquid level, valve position, speed, smoke density, chemical strength, pH, frequency, load, voltage, etc.

Set forth for ready comparison is the complete line of Micromax instruments which offers the pyrometer user appropriate models to indicate, to record, to signal, to control or to perform these functions in any desired combination.

This new catalog contains a wealth of information which everyone who uses or specifies pyrometers will want. To receive a copy, write for Catalog N-33A, Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

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Announcement:

"The Genoms of *Triticum Timopheevi* Zhuk., *Secale cereale* L. and *Haynaldia villosa* Schur.," by Dontcho Kostoff.

Our attention has been recently drawn by the author to an unfortunate error in the article which appeared in the August Number of this Journal, under the title "The Genes of *Triticum Timopheevi* Zhuk., *Secale cereale* L. and *Haynaldia villosa* Schur." Throughout the text the word *genom* which occurred in the original article has been changed to *gene*. The author points out "a very serious mistake has been made in changing the word *genom* to *gene*. *Gene* is the hereditary unit while *genom* means all the *genes* together an organism has in its haploid set of chromosomes." As this change occurs throughout the text, we hasten to draw the attention of our readers to this most regrettable mistake."

Ed.

* * *

We acknowledge with thanks receipt of the following:—

"Actualités Scientifiques et Industrielles," Nos. 330–342, 363–366, 373–374, 399–400.

"The Agricultural Gazette of New South Wales," Vol. XLVII, No. 11, November 1936.

"Journal of Agricultural Research," Vol. 53, Nos. 5 and 6, and Index to Vol. 52.

"The Philippine Agriculturist," Vol. XXV, No. 6, November 1936.

"The Allahabad Farmer," Vol. X, No. 6, November 1936.

"Journal of the Royal Society of Arts," Vol. LXXXIV, Nos. 4379–4382.

"Biochemical Journal," Vol. 30, No. 10, October 1936.

"Journal of the Indian Botanical Society," Vol. 15, Nos. 5 and 6, October and December 1936.

"Chemical Age," Vol. 35, Nos. 904–907.

"Journal of Chemical Physics," Vol. 4, No. 11, November 1936.
"Journal of the Indian Chemical Society," Vol. 13, No. 9, September 1936.
"Berichte der Deutschen Chemischen Gesellschaft," Vol. 69, No. 11.
"Journal de Chimie Physique," Vol. 33, No. 10.
"Experimental Station Record," Vol. 75, No. 4, October 1936.
"Transactions of the Faraday Society," Vol. XXXII, Part II, November 1936.
"Indian Forester," Vol. LXII, No. 12, December 1936.
"Forschungen und Fortschritte," Vol. 12, Nos. 31–33.
Government of India Publications:—
"Monthly Statistics of Production of Certain Selected Industries of India" (Department of Commercial Intelligence and Statistics), No. 5 of 1936–37, August 1936.
"Diseases of Sugarcane and Methods for their Control," by L. S. Subramaniam, Bulletin No. 10, 1936. (Imperial Council of Agricultural Research.)
"Indian Meteorological Department Scientific Notes: A Report on the Administration of the Meteorological Department to the Government of India in 1935–36."
"Indian Trade Journal," Vol. CXXXIII, Nos. 1586–1589.
"The Calcutta Medical Journal," Vol. 31, Nos. 4 and 5, October and November 1936.
"Medico-Surgical Suggestions," Vol. 5, No. 11, November 1936.
"Review of Applied Mycology," Vol. 15, No. 10, October 1936.
"Forest Research in India," 1935–36. Part I. The Forest Research Institute.
"Annual Report of the London Shellac Research Bureau for the year 1935–36."
"Carnegie Institution of Washington Bulletin," Vol. IV, No. 8.
"Journal of the American Museum of Natural History," Vol. 38, No. 4, November 1936.
"Nature," Vol. 138, Nos. 3495–3498.
"Journal of Nutrition," Vol. 12, No. 4, October 1936.
"Science and Culture," Vol. II, No. 5, November 1936.
"Arkiv fur Zoologie," Vol. 28, No. 3, 1936; Vol. 28 A, No. 17, 1936.

Catalogues:

"Mitteilungen über Neuerscheinungen und Fortsetzungen, 1936," No. 5 (Messrs. Verlag Von Gustav Fischer in Jena).
"Books on Astronomy and Mathematics" (Messrs. Wheldon & Wesley, Ltd., London).

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

October 1936. SECTION A.—B. L. GULATEE: *On the Variation of Latitude at Dehra Dūn.*—The diurnal and annual terms in the variation of latitude are discussed. K. C. SUBRAMANIAM: *The Diamagnetism of Some Metallic Halides.*—With zinc, cadmium and mercury halides, there is a general increase in susceptibility when the salts are dissolved in water or methyl alcohol. This is attributed to the release of deformation of the ions of the molecule by the action of the solvent to the extent of ionisation. C. S. Venkateswaran: *The Raman Spectra of Sulphur and Phosphorus. Part II.—Lattice Oscillations.*—An intense sharp line at 36 cm. for solid phosphorus and at 80 cm. for rhombic sulphur are attributed to lattice oscillations. P. NILAKANTAN: *The Magnetic Anisotropy of Rhombic Sulphur.*—The data are in general agreement with results of X-ray measurements. M. K. PARANJPE: *The Convection and Variation of Temperature near a Hot Surface. Part I.—The Dust-Free or Dark Layer in Relation to Surface Convection.*—The formation of a dark or dust-free layer in a space between a hot surface (above) and a cold surface (below), is discussed. B. S. MADHAVA RAO: *Semi-Vectors in Born's Field Theory.* RAM KUMAR BOUNTRA AND KANTILAL C. PANDYA: *The Acid Content of Some of Our Vegetable Foodstuffs. Part II.—Amchur or* Mangifera Indica.—Three organic acids, tartaric, citric, oxalic, have been found in proportion 6, 4, and 1% respectively. CH. V. JOGARAO: *An Optical Investigation of Some Indian Oils. II.—Raman Effect.* V. T. CHIPLONKAR: *The Relative Efficiencies of the Multistage and One Stage Process in the Electrolytic Preparations of Heavy Water.*—Compared with a single stage process, there will be no loss in efficiency if fresh-water is added continuously. R. R. KHANOLKAR, P. M. BARVE AND B. N. DESAI: *Condition of Sparingly Soluble Substances in Gels. Part I.—Silver Chromate in Gelatine.*—Changes in the conductivity and colour of Silver Chromate in gelatine solution have been studied. G. F. MANKODI, P. M. BARVE AND B. N. DESAI: *Importance of Dialysis in the Study of Colloids. Part III.—Colloidal Prussian Blue.*—The changes in cataphoretic speed and viscosity under different conditions show that neither the views of Dhar nor of V. Smoluchowski can individually explain the results. HANS RAJ LUTHRA AND DR. V. I. VAIDHIANATHAN: *Uplift Pressures under Weirs with Three Sheet Piles.*—Working results have been obtained for the design of weirs with three sheet piles.

November 1936. — SECTION A. — B. N. ACHARYA, A. M. PATEL and B. N. DESAI: *Conductivity and Cataphoretic Speed Measurements of Benzopurpurin 4B, Congo Red and Sky Blue F.F.*—The changes observed with concentration are explained on the basis of aggregation of the dye ions to form micelles. B. Y. OKE: *Lattice-Theory of Alkaline Earth Carbonates. Part II.—Elasticity Constants of Aragonite. Part III.—Lattice Energy of the Crystals of Calcite and Its Thermo-Chemical Applications.* B. R. SETH: *On the Flexure of a Hollow Shaft—I.* P. NILAKANTAN: *Magnetic Anisotropy of Naturally Occurring Substances. II. Molluscan Shells.*—The crystalline character of the elements as well as their regularity of arrangement have been established and the probable orientations deduced. E. GORA: *On Fermi's Theory of β-Decay.* S. PARTHASARATHY: *The Visibility of Ultrasonic*

Waves in Liquids.—It is shown that the Heidemann effect repeats at intervals of $d = \lambda^{*2}/2\lambda$ for standing waves, in agreement with the theory of Nagendra Nath. A simple method of deriving the periodic visibility is given as an Appendix by N. S. N. Nath. K. SUBBA RAO AND B. SANJIVA RAO: *Studies in Adsorption on Gels. I. A Comparative Study of Selective Adsorption from Binary Mixtures of Liquids on Gels of Silica, Alumina and Ferric Oxide.*—The chemical nature of a gel markedly affects selective adsorption from binary liquid mixtures. H. GUPTA: *On Sums of Powers.* B. S. MADHAVA RAO: *Complex Representation in Born's Field Theory.* C. B. JOSHI, P. M. BARVE AND B. N. DESAI: *Importance of Dialysis in the Study of Colloids. Part IV. Colloidal Arsenious Sulphide.*—The results are complicated by changes in the composition of the sol. B. ANAND: *Raman Effect in Dibasic Acids in Crystalline State.*—A technique is described for studying Raman Spectra of Crystalline and Amorphous Solids. Results for the first three members of the oxalic acid series are given.

October 1936.—SECTION B.—MANECK B. PITHAWALA: *A Geographical Analysis of the Lower Indus Basin (Sind). Chapter I. Physiography. Chapter II. The Indus—Its History, Regimen and Physics.*—The physiography of Sind has been dealt with especially with regard to the problems of water-supply, economic resources, industrial possibilities, population, etc. The origin of the Indus Basin has also been discussed. The second chapter deals with the geological and recent history of the principal water course of the land, *viz.*, the Indus River. Appropriate maps, sketches, graphs, and charts have been provided and the study constitutes the first pioneering attempt to analyse the geographical features of an Indian Province.

November 1936.—SECTION B.—B. S. KADAM: *Genetics of the* Bansi *Wheat of the Bombay-Deccan and a Synthetic Khapli—Part I.*—The inheritance of pubescence of glumes, colour of grain, colour of glumes, and colour of awns and their interactions is reported. A. VENKATASUBBAN, (MISS) R. KARNAD AND N. N. DASTUR: *Urease Activity of Germinated Seeds.*—Germination of urease-containing seeds brings about the solubilisation of the *desmo* enzyme present in the seeds. B. N. SINGH AND B. R. SINGH: *Growth and Water Requirement of Crop Plants in Relation to Soil Moisture.*—The transpiration rate is analysed with special reference to the growth and water requirements of the plants. The plants studied have either two or three critical periods located in seedling, pre-flowering and ripening stages, when they require a very large amount of water. These periods cover varying number of days in different crops. FROILANO DE MELLO AND (MISS) CIRIACA VALES: Hœmogregarina thyrsoideæ *N.Sp., Parasite of the Indian Eel* Thyrsoidea macrurus *Bleeker.* M. S. RANDHAWA: *A Short Note on an Indian Variety of* Sphæroplea annulina *(Roth.) Agardh. Var.* multiseriata *Var. Nov. A New Species of* Cylindrocapsa *from India.* M. S. RANDHAWA: Cylindrocapsa œdogonioides *sp. nov.* G. N. RANGASWAMI AYYANGAR, K. KUNHI KRISHNAN NAMBIAR AND P. KRISHNASWAMY: *Studies in* Dolichos lablab *(Roxb.) and (L.)—The Indian Field and Garden Bean. III.*—In field varieties of *lablab*, there are seven purple pigmented and one green type. Along with the four seed coat colours, Black, Chocolate, Khaki and Buff, there results sixteen genotypes. These arise by the interaction of four factors K, P, Ch and I, of which K is the basic factor for the seed coat colour series. Data from 160 segregating families are presented in support of the above interpretation.

The Indian Physico-Mathematical Society (*Journal*, 7, No. 2):

S. C. DHAR: *On the Uniformisation of Algebraic Curves of Genus Four:*

The differential equation

$$y'' + \frac{3}{16}\left[\frac{f'(z)}{f(z)} - \frac{2n+2}{2n+1}\frac{f''(z)}{f(z)}\right] y = 0$$

where $f(z) = (z - e_1)(z - e_2) \ldots (z - e_{2n+2})$, occurs in connection with the determination of a variable t such that $s = s(t)$, $z = z(t)$ where $s^2 = f(z)$ and $s(t)$, $z(t)$ are single-valued functions. It is known that t is the quotient of any two solutions of the differential equation. The author shows in this paper that the uniformising variable for the curve $s^2 = 1 + z^9$ which is of genus 4, admits of a Fuchsian group of transformations, and mentions that in a communication to the London Mathematical Society he has proved the result for a curve of any genus belonging to the above type.

RAM BEHARI: *On Levi-Civita's 'Anormalita' of a Rectilinear Congruence:*

Considering a rectilinear congruence in which a typical line passes through (x, y, z) and has direction cosines (X, Y, Z) where x, y, z, X, Y, Z are functions of two parameters u, v, Levi-Civita's Anormalita A is defined by the equations

$$\frac{\partial Y}{\partial z} - \frac{\partial Z}{\partial y} = AX, \quad \frac{\partial Z}{\partial x} - \frac{\partial X}{\partial z} = AY, \quad \frac{\partial X}{\partial y} - \frac{\partial Y}{\partial x} = AZ.$$

The author has introduced in a previous paper (*J. Ind. Math. Soc.*, Vol. I (New Series), p. 135), the concept of 'pitch' of a given ray of the congruence. The pitch p is defined by $\int_C X dx + Y dy + Z dz$ where C is a closed curve on the director surface forming the boundary of an area $d\mathrm{S}$ cut off by a thin pencil of rays of the congruence adjacent to a given ray. In the present paper, the author proves that $\frac{dp}{d\sigma} = A\,\frac{eg - ff'}{E\,G - F^2}$ where $d\sigma$ is the element of area of the spherical representation of $d\mathrm{S}$, and the other letters have their usual meanings in the theory of rectilinear congruences.

The Indian Mathematical Society (*Journal*, 2, No. 3):

RAM BEHARI: *Ruled Surfaces through a Ray of a Rectilinear Congruence:*

Through a line of a rectilinear congruence two ruled surfaces belonging to the congruence can be drawn so as to have any one of the properties: (*a*) They have the same central point on the line, (*b*) Their lines of striction lie on the focal sheets, (*c*) Their parameters of distribution are equal to a given constant.

Some properties of these surfaces are considered, mainly dealing with the 'pitch' of the line.

R. C. BOSE: *A Theorem on Equiangular Convex Polygons Circumscribing a Convex Curve:*

The following theorem is proved:

Given a closed convex curve V, with perimeter L and an integer $n \geqslant 3$ we can find at least two n-sided convex equiangular polygons, circumscribing V and having the perimeter $\frac{n\,L}{\pi} \tan \frac{\pi}{n}$, *i.e.*, a perimeter equal to the perimeter of a regular n-gon circumscribing a circle of perimeter L.

As a corollary, if $\bar{S}$ and $\underline{S}$ denote the maximum and minimum perimeters of n-sided convex equiangular polygons circumscribing V, then

$$\bar{S} \geqslant \frac{nL}{\pi} \tan \frac{\pi}{n} \geqslant \underline{S}$$

T. VENKATARAYUDU: *On the Significance and the Extension of the Chinese Remainder Theorem:* The so-called Chinese Remainder Theorem is interpreted by the author as establishing a definite isomorphism between a vector modular algebra and a scalar modular algebra. An extended form of the theorem is set forth, and this is employed to determine a set of normal basis elements from a given set of basis elements of an Abelian group.

V. LEVIN: *Two Remarks on Hilbert's Double Series Theorem:*

An improved form of Hilbert's Double Series theorem (*vide* Hardy, Littlewood and Polya: *Inequalities*, Chap. IX) is given, *viz.*,

$$\sum_0^\infty \sum_0^\infty \log \frac{(m+n)^{m+n}\ (m+n+2)^{m+n+2}}{m+n+1^{2(m+n+1)}}\ a_m b_n < \pi \left(\sum_0^\infty a_m{}^2\right)^{\frac{1}{2}} \left(\sum_0^\infty b_n{}^2\right)^{\frac{1}{2}}$$

where a_m and b_n are real positive numbers, all the a's or b's not vanishing.

Another theorem, again an improvement upon a known inequality, is given, *viz.*:

If

$$p > 1,\ q > 1,\ \frac{1}{p} + \frac{1}{q} \geqslant 1,\ p' = \frac{p}{p-1},\ q' = \frac{q}{q-1},$$

$$\lambda = \frac{1}{p'} + \frac{1}{q'},\ \text{then}$$

$$\sum_1^\infty \sum_1^\infty \frac{a_m\, b_n}{(m+n)^\lambda} \leqslant \mathrm{K} \left(\sum_1^\infty a_m{}^p\right)^{1/p} \left(\sum_1^\infty b_n{}^q\right)^{1/q},$$

when

$$\mathrm{K}\ \text{is taken as}\ \left(\pi\ \mathrm{cosec}\ \frac{\pi}{\lambda p'}\right)^\lambda = \left(\pi\ \mathrm{cosec}\ \frac{\pi}{\lambda q'}\right)^\lambda.$$

If $q = p'$, this gives the known best value of K for this case, *viz.*, $\pi\ \mathrm{cosec}\ \pi/p$.

S. S. PILLAI: *On Sets of Square-free Numbers:* Let $N(x) = N(x, d_1, d_2, \ldots d_{r-1})$ denote the number of groups of square-free numbers $q_1, q_2 \ldots q_r$ not exceeding x, such that $q_m - q_1 = d_{m-1}$, $(m = 2, 3, \ldots r)$. Let $f(p)$ be the number of different residue classes modulus p^2 and not congruent to 0 contained in the set $d_1, d_2, \ldots d_{r-1}$. Then it is proved that

$$N(x) = Ax + O\left(\frac{x}{\log x}\right) \text{ where}$$

$$A = \frac{\pi}{p} \left\{1 - \frac{1 + f(p)}{p^2}\right\}.$$

S. S. PILLAI: *On* $a^x - b^y = c$:

By using Aaron Herschefeld's method of proof for the special case $2^x - 3^y = d$ (*Bull. Amer. Math. Soc.*, XLII) and the results of a previous paper by the author (*J. I. M. S.*, Vol. XIX), it is proved here that when c is large the equation $a^x - b^y = c$ has at most one solution. Further, if a, A, b, B, c are given positive integers and c is sufficiently large, then the equation $Aa^x - Bb^y = c$ can have at most one solution.

J. L. SHARMA: *On Integrals Involving Lamé Functions:*

Lamé's differential equation

$$\frac{d^2y}{du^2} = [n(n+1)\ \wp(u) + B]\ y$$ where n is integral,

admits the solutions

$$F_n(u) = \frac{n}{1}\pi \left[\frac{\sigma(u + a_r)}{\sigma(u)\ \sigma(a_r)}\ e^{-u\zeta(a_r)}\right]$$

$$F_n(-u) = \frac{n}{1}\pi \left[\frac{\sigma(a_r - u)}{\sigma(-u)\ \sigma(a_r)}\ e^{u\zeta(a_r)}\right]$$

Calling these functions as generalised Lamé functions, the author proves that they form a non-orthogonal set of functions.

Also, the integral of the product of any two solutions of Lamé's equation for a fixed value of n is different from zero unless both of them are of the first kind and of the same species.

Indian Mathematical Society:

The Mathematical Student, *June* 1936.——E. H. NEVILLE: *Two Determinants.*

Let $a_1, a_2, \cdots$ and $d_1, d_2, \cdots$ be two sets of numbers, and let $a_r{}^{(s)} = (a_r + d_1)\ (a_r + d_2) \cdots (a_r + d_s)$,

Then $\begin{vmatrix} 1 & a_1{}^{(1)} & a_1{}^{(2)} & \cdots & a_1{}^{(n-1)} \\ 1 & a_2{}^{(1)} & a_2{}^{(2)} & \cdots & a_2{}^{(n-1)} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ 1 & a_n{}^{(1)} & \cdots & \cdots & a_n{}^{(n-1)} \end{vmatrix} = (\zeta 1)(a_1 a_2 \cdots a_n),$

the product of all the differences $a_r - a_q$ with $r > q$.

If we consider a similar determinant with one absent column, *i.e.*, if F_q be a determinant with a typical row

$$[1, a_r{}^{(1)}, a_r{}^{(2)}, \cdots a_r{}^{(q-2)}, a_r{}^{(q)}, a_r{}^{(q+1)}, a_r{}^{(q+2)}, \cdots a_r{}^{(n)}],$$

then $F_q = \zeta 1\ (a_1, a_2 \cdots a_n)$

$\{A_{n-q+1} + A_{n-q} H_1 + A_{n-q-1} H_2 + \cdots + A_n H_{q-1}\}$

where $A_1, A_2 \cdots$ stand for $\Sigma a_1, \Sigma a_1 a_2$, etc., and H_s is the sum of the homogeneous products of degree s that can be formed from $d_1, d_2 \cdots d_r$.

B. RAMAMURTI: *On the Lines of Striction of a Quadric.*—Let a central quadric be referred to its generators such that λ and μ, the parameters of the generators through any point are equal for every point on the conic section q at infinity, and let this common value be also the parameter of the point considered as a point on the conic q. If $a_x{}^4 = 0$ give the parameters of the points of contact with q of the common tangents between q and the circle at infinity Ω, then the two lines of striction are given by $a_\lambda{}^3 a_\mu = 0$ and $a_\mu{}^3 a_\lambda = 0$. The author deduces from this that the two curves intersect in ten points, six of which are the vertices of the quadric, and the other four are the points of contact of the isotropic tangent planes.

V. THÉBAULT: *On Certain Remarkable Points Connected with a Triangle.*—Certain elementary

calculations are worked out connected with the associated points and circles of a triangle. The following theorems are deduced :—

Let (α, β, γ) and $(\alpha', \beta', \gamma')$ be the centres of the squares constructed exteriorly and interiorly on the sides of a triangle ABC which is not right-angled, O the centre of the circumcircle, H′ the orthocentre of the pedal triangle A′B′C′. If we take the nine perpendiculars from (α, β, γ) or $(\alpha', \beta', \gamma')$ to the three sides of the triangle as representing nine forces, these have a resultant which is represented in magnitude and direction by the line Segment $\overline{OH'}$.

The resultant of nine forces represented by the perpendiculars from (α, β, γ) or $(\alpha', \beta', \gamma')$ to the three sides of the right-angled triangle ABC, is represented in magnitude and direction by the line segment OK′ joining the circumcentre O to its "symmetrique" K′ with respect to the Lemoine point K of ABC.

C. N. SRINIVASIENGAR: *On the Nature of Contact between $S = O$ and $S - \lambda T = O$.*—The theorem on this topic given by S. S. Pillai in *Math. Student*, Vol. III, No. 4, is proved here by a different method which is applicable to any system of Cartesian co-ordinates. The theorem is also extended to three dimensional geometry as follows, with a suitable definition of internal and external contact.

The two surfaces $S \equiv F(x, y, z) = 0$ and $S - \lambda T = 0$ where $T \equiv (x - x_1)\frac{\partial F}{\partial x_1} + (y - y_1)\frac{\partial F}{\partial y_1} + (z - z_1)\frac{\partial F}{\partial z_1}$, and $F(x_1, y_1, z_1) = 0$, touch each other internally or externally according as $\lambda < 1$ or $\lambda > 1$.

A. NARASINGA RAO: *On the Contact of Varieties in n-Space.*—Two varieties in $[n]$ which touch at O are defined to have external or internal contact according as every plane section of them through O but not lying in the tangent prime at O gives curves which have external or internal contact. If the contact is external for some sections and internal for others, the contact is said to be "neutral".

Let a variety in $[n]$ touching $x_n = 0$ at O be written

$$x_n = \sum a_{rs}\, x_r\, x_s + \sum a_{rst}\, x_r\, x_s\, x_t + \cdots\cdots$$

Calling $\sum a_{rs}\, x_r\, x_s$ as the asymptotic form of the variety at O, the author proves that two varieties in $[n]$ which touch at O have non-neutral contact when their asymptotic forms at O are either both definite or if indefinite, one is a multiple of the other. In the former case, the contact is internal or external according as the definite forms are of like or unlike sign; in the latter, according as the numerical multiplier is positive or negative. In every other case, the contact is neutral. The author thence works out the generalisations for n-space the results of S. S. Pillai and C. N. Srinivasiengar for [2] and [3], and points out that the character of the contact is unaltered by projective transformations.

V. RANGACHARIAR: *Note on Convergence of a Certain Series*:

Consider the power series $y = a_0 + a_1 z + a_2 z^2 + \cdots$ where $zx = 1$ and $a_n (A + B_n) - a_{n-1}(C + D_n) + a_{n-2}(E + F_n) = 0$. For the case $A = 0, B = a_0 = 1, C + D = a_1$, the sum of the series is shown to be of the form $\left(1 - \frac{a}{x}\right)^{-\alpha}\left(1 - \frac{b}{x}\right)^{-\beta}$, where a, b, α, β are constants depending on B, C, D, E, F.

Mr. V. Ganapati Iyer explains that the solution in the general case depends on the solution of a certain differential equation of the first order, regular at $Z = O$ and taking the value $y = a_0$ when $z = 0$. S. SURYANARAYANA IYER: *A Proof of Newton's Theorem.*—The author points out a fallacy which may arise in the application of Newton's Theorem about conics, and gives a new geometrical proof of the theorem.

C. N. S.

Calcutta Mathematical Society:

November 29, 1936.—R. C. BOSE: *Theory of Skew Rectangular Pentagons in Hyperbolic Space. Part II.* M. DE. DUFFAHEL (STAMBOUL): *Sur l'Equation aux derivees partielles qui se presente dans la theorie de la propagation de l'Electricite.* M. DE. DUFFAHEL (STAMBOUL): *Sur les couples de Fonctions uniformes d'une variable.* B. B. SEN: *Note on the Transverse Vibration of Freely Supported Plates under the Action of Moving Loads and Variable Forces.* R. S. VARMA: *An Infinite Integral Involving Bessel Function and Parabolic Cylinder Function.* N. RAMA RAO AND BASAVA RAJU: *An Extension of Wilson's Theorem.* S. P. SLONGUINOFF (PERM, U. S. S. R.): *Equation de Laplace dans l'espace a'deuse dimensions.* OLGA TAUSSKY (CAMBRIDGE): *Rings with Non-Commutative Addition.* S. GHOSH: *On the Solution of Laplace's Equation Suitable for Problems Relating to Two Spheres Touching each other.* S. GHOSH: *Stress Distribution in a Heavy Circular Disc held with its Plane Vertical by a Peg at the Centre.*

Indian Chemical Society:

August 1936.—S. S. BHATNAGAR, A. N. KAPUR AND P. L. KAPUR: *A Magnetic Study of Colour Changes in Cobalt Chloride. Part II.* PRIYADARANJAN RAY AND AMALENDRA NARAYAN GHOSH: *Complex Metal-ammonium Selenites and Selenito-metal-ammines.* C. C. PALIT AND N. R. DHAR: *Oxidation of Glucose in Presence of Insulin Glutathione and other Substances and the Probable Mechanism of Biological Oxidations.* S. C. DE AND P. C. RAKSHIT: *Synthesis in the Pyrazolone Series. Part IV.—Action of Aminoguanidines on β-Ketonic Esters and β-Diketones.* MATA PRASAD, M. P. LAKHANI AND JAGDISH SHANKAR: *An X-Ray Investigation of the Crystals of* p-*Nitrodiphenyl.* DINES CHANDRA SEN: *Studies in the Camphor Series. Part III. Tautomeric Behaviour of Thiocamphor and the Activity of its Sodium Derivatives.* M. Q. DOJA: *The Quaternary Ammonium Iodides of Dimethyl-*p*-toluidine.* RADHA RAMAN AGARWAL: *Chemical Examination of* Cuscuta reflexa Roxb. *Part IV.—Isolation of a New Yellow Flavone Colouring Matter from the Seeds.* NRIPENDRA NATH CHATTERJEE: *Spiro-compounds. Part I.—A New Route to Spiro-compounds. Synthesis of* Cyclo*hexane-spiro*-cyclo-*pentane.* M. Q. DOJA AND A. MOKEET: *Preparation of* p-*Diethylamino-benzaldehyde.* M. B. RANE, K. KONDAIAH, AND M. K. RATNAM: *Removal of Antimony from its Solutions by Nitric Acid.* S. D. SUNAWALA: *A Note on the Estimation of Formic Acid in Commercial Acetate of Lime. Review.*

Society of Biological Chemists, India:

Oct. and Nov. 1936.—A. KRISHNAMURTY: *Some Aspects of Malting.* B. A. SUNDARA IYENGAR: *Iron Mobilization and Plant Growth in Water-logged Soils.* PROF. C. R. NARAYAN RAO: *Is Man Part of the Animal World?* K. RAMI REDDI: *Biochemistry of Sonti Fermentation.* K. VENKATA GIRI: *Rôle of Phosphatases in Plants.* N. N. DASTUR AND K. V. GIRI: In vitro *Digestion of Fats.* V. K. BADAMI: *Influence of X-Rays on Plants.* K. V. GIRI AND P. N. BHARGAVA: *New Methods for the Detection of Adulteration in Food-stuffs.* A. Sreenivasan: *Influence of parboiling on Quality of Rice.*

Indian Botanical Society:

October, 1936.—M. A. GINAI: *Further Contribution to Our Knowledge of Indian Coprophilous Fungi.* J. C. BANERJI: *Studies on the Myxophyceæ of Lower Bengal. I.—Preliminary Observations on the Group in Relation to Salient Ecological Factors and Systematic Enumeration of a Few Chroococcaceæ.* R. H. DASTUR AND D. E. WADIA: *A Study of Some Physico-Chemical Changes in Leaf Movements.* M. O. P. IYENGAR: Characiosiphon, *a new member of the Chlorophyceæ.—Preliminary Note.* B. SAHNI: *Wegener's Theory of Continental Drift in the Light of Palæobotanical Evidence.*

December, 1936.—V. S. RAO: *Studies on Capparidaceæ II.—The Embryology of* Gynandropsis Pentaphylla. R. K. SAKSENA: *Structure of the Nucleus in the Genus Pythium.* A. R. RAO: *A New Form of Botrydium from Lucknow.*

Meteorological Office Colloquium, Poona:

September 15, 1936.—MR. M. K. PARANJPYE: *'The Dust-Free or Dark Layer in Relation to Convection near Hot Surfaces.'*

October 10, 1936.—DR. S. CHANDRASEKHR (Fellow of the Trinity College, Cambridge, and Associate Research Professor of the Chicago University), "Luminosity of Gaseous Nebulæ":—After describing the characteristic features of gaseous nebulæ, Dr. Chandrasekhar discussed the physics of the luminosity of gaseous nebulæ. The luminosity of these bodies is now known to be derived from the radiant energy received by them from an adjacent star. The primary process is the ionization of the gaseous matter of the nebulæ—mostly hydrogen and helium. The subsequent return of the electron to the ionized atom causes the emission of the Lyman lines and of the He I and He II lines. These, in their turn, cause secondary emission of lines from atoms of the same kind and also from certain other atoms. For example, a few O III and N III lines are selectively excited by certain chance coincidences of He II, O III and N III lines. Another important mechanism of emission is the following: In the primary process of ionization, electrons are ejected from hydrogen and helium with energies equal to the difference between the energy of the incident quantum and the energy equivalent of the ionization potential of the atom. These electrons have comparatively low potential energies and their impact on atoms like O III and N III is responsible for raising them to metastable states and subsequent emission of low potential forbidden lines.

October 27, 1936.—DR. S. R. SAVUR.—"An improvement of the existing forecasting formulæ."

October 30, 1936.—DR. K. DAS described the Cosmic Ray apparatus used by Dr. Victor Neher (of the Californian Institute of Technology) at Madras where he let off a number of these instruments with balloons during October 1936, assisted by Dr. Das. With the help of an instrument which had kindly been sent by Dr. Neher on loan, he explained the mechanism of its working.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

University of Allahabad:

Mr. S. P. Naithani, Lecturer, B grade, Botany Department, returned from abroad after taking his PH.D. degree from the London University.

The Right Hon'ble Sir Tej Bahadur Sapru has donated a sum of Rs. 900 a year for the award of scholarships to poor students in the manner decided by the Vice-Chancellor. A similar donation of Rs. 500 from Professor Amaranatha Jha, Dean of the Faculty of Arts, Allahabad University, has been placed at the Vice-Chancellor's disposal for any non-recurring expenditure which may be considered desirable in the interests of the University. Messrs. H. K. Ghosh, Beni Madho and I. D. Varshney have offered scholarships for the B.COM. students of the University from this session.

The Ordinances for the degrees of D.Sc. and D.LITT. have been thoroughly revised and a new D.PHIL. degree has been instituted under the Faculties of Arts and Science.

Messrs. R. N. Kaul and M. U. Ahmad, Lecturers in the Philosophy Department, have been appointed delegates to the Philosophical Congress which will be held at Delhi in December 1936.

Aligarh Muslim University:

Mr. Mohd. Afzal Husain Qadri, M.SC. (Alig.), has been awarded the degree of Doctor of Philosophy, in Zoology, of the Aligarh Muslim University. He submitted the following four papers bearing on the work done under the guidance of Dr. M. B. Mirza, Director, Zoological Laboratories.

(1) "Studies on the Mallophaga of North-Indian Birds." (*Zeit. f. Parasit.*, 1935, **8**, Ht. 2).
(2) "Studies on the Mouth Parts of Mallophaga infesting North-Indian Birds." (*Proc. Ind. Acad. Sci.*, 1935, **3**, No. 5).
(3) "Some New Mallophaga from North-Indian Birds." (*Zeit. f. Parasit.*, 1936, **8**, Ht. 6).
(4) "The Male Genetalia of Mallophaga Infesting North-Indian Birds." (*Proc. Ind. Acad. Sci.* (in press).

Lucknow University:

The following Science Lectures have been arranged for the Winter Session (1936–37). The lectures will be held at 6-30 P.M. in the halls indicated.

*Dec. 4 and 5 (Chemistry Theatre).—
"The mechanism of chemical reactions." By Dr. A. C. Chatterji.

*Dec. 13 (Biology Theatre).—
"Recent geological changes in Northern India and their effect upon the drainage of the Indo-Gangetic basin." By Mr. D. N. Wadia.
*Jan. 8 and 9 (Chemistry Theatre).—
"Electrolysis of solutions." By Dr. S. N. Shukla.
Jan. 13, 14 and 15 (Biology Theatre).—
"The elements of the modern theory of aggregates." By Dr. A. N. Singh.
*Jan. 16 and 17 (Biology Theatre).—
"Competition in the plant world." By Dr. S. C. Verma.
*Jan. 22 and 23 (Chemistry Theatre).—
"The relation between physical properties and chemical constitution." By Mr. M. R. Nayar.
*Jan. 28 and 29 (Biology Theatre).—
"Mitogenetic rays." By Dr. S. N. Das Gupta.
*Jan. 30 (Biology Theatre).—
"Earth movements, vertical and horizontal." By Dr. B. Sahni.
*Feb. 8 and 9 (Biology Theatrre).—
1. "Helminthology and Agriculture." 2. "Helminthiasis in domestic animals." By Dr. G. S. Thapar.
(*These lectures will be illustrated.)

University of Madras:

Mr. Hadi Hasan of the Aligarh Muslim University delivered, under the auspices of the University, a lecture on "Arab Additions to Greek Learning" at the Government Muhammadan College, Madras, on the 10th October 1936.

A special meeting of the Senate was held on the 30th October 1936 to award the following titles and diplomas:—

Oriental Titles:—	
1. Siromani	62
2. Vidvan	130
3. Afzal-ul-Ulama	9
4. Munshi-i-Fazil	11
Diploma in Midwifery	5
,, Economics	3
,, Modern European Languages	8
,, Geography	7
,, Indian Music	9

The ordinary meeting of the Senate was also held on the 30th and 31st October 1936.

University of Mysore.

Convocation.—The 19th Annual Convocation for conferring degrees was held in Mysore on the 29th October 1936, His Highness the Pro-Chancellor presiding. Dr. E. P. Metcalfe, D.Sc. F. Inst.P., Vice-Chancellor, delivered the Convocation address.

289 candidates were presented for degrees in person and 26 candidates were admitted to degrees *in absentia*.

Meeting of the Senate.—A special meeting of the Senate was held on the 30th October 1936, for the election of three members of the University Council by and from the Senate, at which the following were elected:—

1. Mr. M. Sultan Mohiyuddin. M.A., LL.B., M.Ed., Deputy Director of Public Instruction in Mysore, Bangalore.
2. Mr. D. V. Gundappa, Proprietor, Karnataka Publishing House, Bangalore City.
3. Mr. Mirle N. Lakshminaranappa, B.A., LL.B., Advocate, Bangalore City.

Faculties.—Mr. E. K. Ramaswami, B.Sc., A.C.G.I., M.A.S.M.E., M.I.E., Professor of Mechanical Engineering, College of Engineering, Bangalore, was elected Dean of the Faculty of Engineering and Technology.

Extension Lectures.—The following extension lectures were delivered:

1. Mr. B. M. Srikantia, M.A., B.L., Professor of English, Central College, Bangalore, on "Life and Teaching of Basavanna" at Davanagere and on "Shakespeare's Historical Plays" at Chitaldrug, both in Kannada.

2. Mr. O. C. Gangoly of Calcutta, on (*a*) "History of Indian Painting," (*b*) "What is Art." at Bangalore and Mysore, in English.

L.M.P. Examinations.—The several L.M.P. Diploma Examinations for the year 1936 were held on the 1st and 2nd October with the following results:—

	No. examined	No. passed
First Examination ..	10	5
Second Examination..	34	20
Third Examination	41	24
Final Examination ..	47	19

Meeting of the Senate.—The Ordinary Meeting of the Senate for the year was held on the 26th November 1936. Among the propositions that were passed, mention may be made of the following:—

(1) Addition of Hindi to the list of subjects for which Boards of Studies and Boards of Examiners have to be appointed. (2) Establishment of a University Training Corps. (3) Provision of a sum of Rs. 10,000 in the Budget for the publication of short books in Kannada on subjects of modern scientific interest. (4) Arrangement for securing consideration of the cases of graduates and under-graduates of the University in connection with appointment to vacancies occurring in the Postal and Telegraphic Departments within the Mysore State.

Extension Lectures.—The following Extension Lectures were delivered:—

(i) Mr. K. V. Puttappa, M.A., "Tragic Karna of Kumāravyāsa" in Kannada, at Tumkur, Madhugiri and Davangere. (ii) Rev. J. B. Freeman, M.A., L.T., Ph.D., C.D., "The Time Concept" in English, at Mysore. (iii) Mr. H. K. Ramiengar, M.A., "Village or Rural Industries," in Kannada, at Arsikere and Chickballapur. (iv) Mr. K. Sundaresan, L.M. & S., "Nutrition" in Kannada at Mysore and Bangalore. (v) Dr. K. N. Venkatasubba Sastri, M.A., Ph.D., F.R.Hist.S., "The History of Mysore Administration" in Kannada at Bangalore.

ERRATUM.

Vol. V, November 1936, page 244, *add* at the end of 2nd column.—

[1] *Am. Chem. Abs.*, 1922, **16**, 2323.
[2] *J. Am. Chem. Soc.*, 1931, **53**, 1106.
[3] *Cf.* Haworth and Perkin, *J.C.S.*, 1898, **73**, 330.
[4] *Cf.* Guha, Presidential Address, Chemistry Section, *Proc. Indian Sci. Cong.*, 1936, p. 115; Linstead, *Ann. Rep.*, 1935, **32**, 315 footnote.

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